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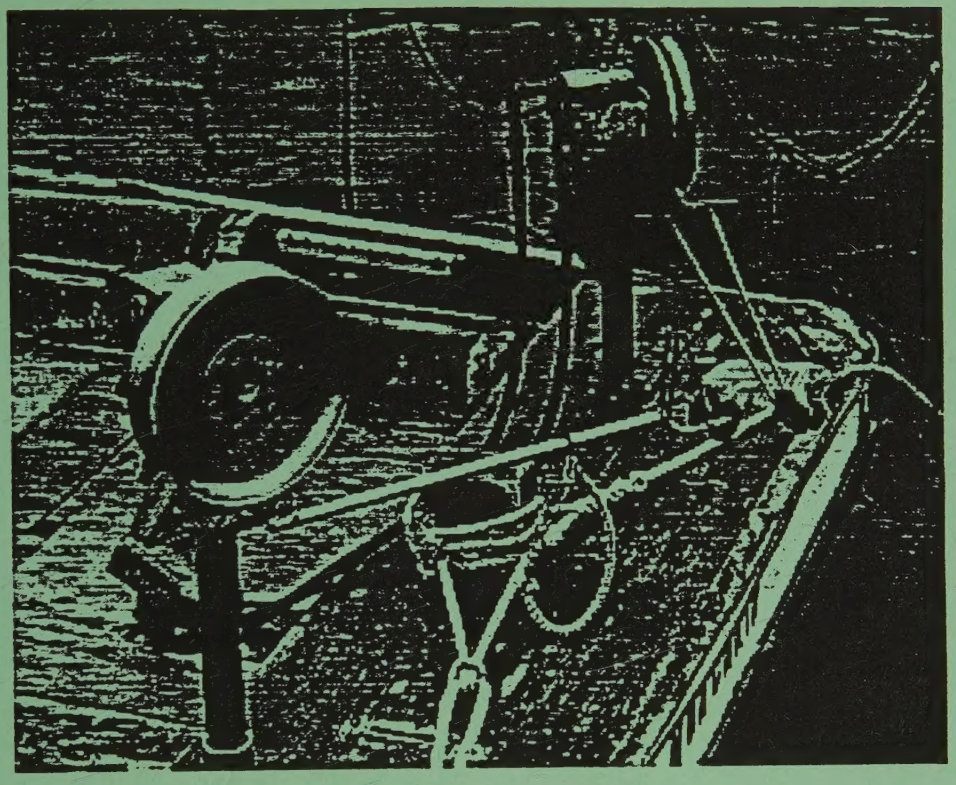
1996 Annual Report



November 1997

Western Pacific Regional Fishery Management Council
1164 Bishop Street, Suite 1400, Honolulu, Hawaii 96813

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Bottomfish and Seamount Groundfish Fisheries of the Western Pacific Region

1996 Annual Report

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CONTENTS

page

1.0 INTRODUCTION 1
1.1 Definition of Descriptors 1
1.1.1 Landings information 1
1.1.2 Effort information 4
1.1.3 Participation information 4
1.1.4 Economic information 4
1.2 Definition of Indicators 4
1.2.1 Aggregate Catch-Per-Unit-Effort 4
1.2.2 Mean Fish Size 5
1.2.3 Percent Immature 5
1.2.4 Spawning Potential Ratio 5
1.2.5 Economic Indicators 5

2.0 AREA SUMMARIES 5
2.1 American Samoa 5
2.1.1 Descriptors 5
2.1.2 Indicators 6
2.1.3 Recommendations 6
2.2 Guam 6
2.2.1 Descriptors 6
2.2.2 Indicators 7
2.2.3 Recommendations 7
2.3 Hawaii 8
2.3.1 Descriptors 8
2.3.2 Indicators 9
2.3.3 Recommendations 11
2.4 Northern Mariana Islands 11
2.4.1 Descriptors 11
2.4.2 Indicators 12
2.4.3 Recommendations 12
2.5 Region-Wide Recommendations 13

TABLES

page

1. Regional Summary of 1996 Bottomfish Statistics 2
2. Bottomfish Management Unit Species (BMUS) Names 3

APPENDICES

page

1. American Samoa 1-1
2. Guam 2-1
3. Hawaii 3-1
4. Northern Mariana Islands 4-1
5. NMFS 1996 Administrative Activities 5-1
6. NMFS 1996 Enforcement Activities 6-1
7. Protected Species and Habitat 7-1
8. 1996 Bottomfish Plan Team Members 8-1
9. Definitions and Common Acronyms 9-1

SUMMARY OF ISLAND AREA TABLE OF CONTENTS

Appendix 1. American Samoa

Contents page

1. Summary 1-2
2. Historical Annual Statistics 1-3
3. List of Tables 1-4
4. List of Figures 1-4
5. Introduction 1-5
6. Recommendations 1-5

Tables page

1. American Samoa 1996 Estimated Total Bottomfish Landings 1-6
2. American Samoa 1996 Estimated Average Price of Bottomfish Species 1-8

Figures page

1. American Samoa Bottomfish Landings 1-10
2. American Samoa annual estimated commercial bottomfish landings 1-12
3. American Samoa annual estimated bottomfish hours and trips 1-14
4. American Samoa annual estimated number of boats landing bottomfish 1-16
5. American Samoa average price of bottomfish 1-18
6. American Samoa annual bottomfish CPUE 1-20
7. American Samoa annual estimated spawning potential ratio for bottomfish complex 1-22
8. American Samoa average inflation-adjusted revenue per trip landing bottomfish 1-24

Appendix II. Guam

Context page

1. Introduction 2.2
2. Summary 2.3
3. Historical Annual Statistics 2.4
4. Recommendations 2.5

5. List of Tables 2.7
6. List of Figures 2.7

Tables page

1. Guam 1996 expanded creel survey composition of allocated bottomfish management unit species (BMUS) 2-8
2. Guam 1996 commercial bottomfish average price 2-11

Figures page

1. Guam harvest of BMUS and all bottomfish 2-9
2. Total and commercial BMUS harvest, and revenue 2-12
3. Estimated boat hours and trips 2-14
4. Guam bottomfish fishery participation 2-16
5. Average bottomfish prices 2-18
6. Guam bottomfish CPUE 2-20
7. Guam average revenue per trip 2-22

Appendix 3 Hawaii

Contents page

1. Introduction 3-2
2. Summary 3-2
3. Recommendations 3-3
4. List of Tables 3-4
5. List of Figures 3-4
6. Historical Annual Statistics 3-5

Tables page

1. Historical Annual Statistics Main Hawaiian Islands 3-5
2. Historical Annual Statistics Mau Zone 3-5
3. Historical Annual Statistics Hoomalu Zone 3-6
4. Hawaii Bottomfish Market Ex-vessel Prices by Species 3-34
5. NWHI Ho'omalu zone bottomfish vessel income statement 3-36
6. NWHI Ho'omalu zone bottomfish vessel economics 3-37
7. NWHI Mau zone bottomfish vessel income statement 3-38
8. NWHI Mau zone bottomfish vessel economics 3-39
9. "Optimal" number of NWHI bottomfish vessels 3-40

Figures page

1. Hawaii's bottomfish landings from the NWHI and MHI 3-7
2. NWHI BMUS species composition per trip by weight 3-10
3. NWHI BMUS species compostion by weight 3-13
4. Number of trips made by NWHI bottomfish fleet 3-15
5. Number of vessels in the NWHI bottomfish fleet 3-17
6. MHI species composition of landings by weight 3-19
7. Standard MHI bottomfishing trips and vessels 3-21

8. Current year and historical catch compostion 3-23
9. Hawaii domestic bottomfish landings and revenue 3-24
10. Hawaii bottomfish market
(annual *inflation-adjusted ex-vessel prices and domestic landings) 3-26
11. Hawaii bottomfish landings and revenue by source 3-27
12. Hawaii bottomfish ex-vessel prices by source 3-29
13. Hawaii bottomfish ex-vessel prices by zone 3-31
14. NWHI bottomfish inflation-adjusted revenue per trip by zone 3-34
15a. CPUE for Hawaiian bottomfish 3-42
15b. Partial CPUE for MHI bottomfish 3-45
15c. Partial targeted CPUE for MHI bottomfish 3-48
16. Percent immature in Hawaiian bottomfish catch 3-51
17. Mean weight of Hawaiian bottomfish 3-53
18a. Spawning potential ratio (SPR) for MHI bottomfish using aggregate CPUE 3-55
18b. Spawning potential ratio (SPR) for MHI bottomfish using targeted CPUE 3-57
19. Spawning potential ratio (SPR) for NWHI bottomfish 3-59
20. Research CPUE on SE Hancock Seamount 3-61
21. Armorhead SPR 3-64
22. Armorhead CPUE 3-64

Apendix IV. Northern Mariana Islands

Contents

1. Introduction 4.2
2. Summary 4.3
3. Recommendations 4.4
4. List of Tables 4.5
5. List of Figures 4.5

Tables

page
1. NMI 1994 commercial landings of bottomfish species 4-7

Figures

page
1. NMI commercial bottomfish landings and revenue 4-6
2. Number of NMI fishermen (boats) making bottomfish landings 4-8
3. Number of NMI bottomfish trips 4-9
4. NMI average price of bottomfish 4-10
5. NMI average inflation adjusted revenue per trip landing bottomfish 4-11
6. NMI bottomfish catch in average pounds per trip 4-13

Bottomfish and Seamount Groundfish Fisheries of the Western Pacific

1996 Annual Report

1.0 INTRODUCTION

The 1996 annual report provides a set of descriptors and indicators of the bottomfish fisheries from American Samoa, Guam, Hawaii and the Northern Mariana Islands. The descriptors are designed to document recent trends in landings, effort, participation, revenue and prices. Should management action be recommended, descriptor information will aid in assessing potential impacts of the action on fishery participants. The indicators are quantifiable and measurable tools used to identify signs of stress in the stocks or the fishery. Based on changes over time in indicator levels, the Bottomfish Plan Team (BPT) may identify "yellow light" situations (i.e., where stress is first detected) and recommend that either management action or additional study be undertaken or "red light" situations where immediate management action is needed.

The annual report is organized as follows: The introduction section defines and briefly explains the descriptors and indicators. The next section briefly summarizes time trends in descriptor and indicator levels, through the current year, and recommends any areas of concern for each island area. Reports from each island area are appended. The introduction describes the history and present characteristics of the fishery. Results of the current year's descriptors and indicators are presented in detail, in relation to past temporal trends. Figures are supported with information on source of the data, methods of calculation, and data interpretation. Table 1 summarizes 1996 bottomfish statistics for the region. The appended report from each area concludes with a summary, which addresses progress made on the previous year's recommendations, and new recommendations. Finally, additional appendices contain information on NMFS 1996 administrative and enforcement activities, habitat conditions, protected species interactions, and 1996 BPT membership.

Table 2 lists scientific, common English and local/indigenous names for bottomfish management unit species (BMUS) for each area (American Samoa, Guam/Northern Marianas, and Hawaii).

1.1 Definition of Descriptors

The fishery descriptors are defined as follows:

1.1.1 Landings information

Time series information on aggregate catch for each island area shows recent trends in total bottomfish harvest. For American Samoa and Guam, estimates of both the commercial landings and the total landings (combined commercial, recreational and subsistence) are available. For Hawaii and the Northern Marianas, landings information represents only the commercial harvest.

Table 1. Regional Summary of 1996 Bottomfish Species

				Hawaii			
	AS	GU	MP	All	MHI	Mau	Hoomalu
BMUS Landings (lb)	32,245	54,122	52,967	903,000	421,000	135,000	176,000
Revenue ($)	62,878	17,492[4]	176,707	2,577,000	1,540,000	note 3	note 3
No. Of Boats	26	400	70	---	1079	12	3
No. Of Trips	262	7,790	446	---	6,987	81	26
CPUE	17.5lb/hr	4.6 lb/hr	119 lb/trip	---	176 lb/trip	2,876 lb/trip	5,588 lb/trip
SPR	0.58	---	---	---	note 1	note 2	note 2

Note:

1) Species with Spawning Potential Ratio near or below critical level of 0.20 (recruitment overfished): onaga ("targeted" SPR = 0.05); ehu ("targeted" SPR = 0.08); hapuupuu ("best/worst" SPR = 0.21)
2) Healthy (SPR > 0.20) for all species
3) Revenue for NWHI zones combined was $993,000
4) Revenue based on commercial landing of 6,578 pounds

Table 2. Bottomfish Management Unit Species (BMUS) Names

(Absence of an indigenous name implies no local name established or area is not within the species' geographic range.)

Scientific	English Common	American Samoa	Guam/ CNMI	Hawaii
Bottomfish:				
Aphareus rutilans	red snapper/silvermouth	palu-gutusiliva	maraap tatoong	lehi
Aprion virescens	gray snapper/jobfish	asoama	tosan	uku
Caranx ignobilis	giant trevally/jack	sapoanae	tarakito	white ulua/pau'u
C. lugubris	black trevally/jack	tafauli	trankiton attilong	black ulua
Epinephelus fasciatus	blacktip gouper	fausi	gadao matai	
E. quernus	sea bass			hapu'upuu
Etelis carbunculus	red snapper	palu-malau	guihan boninas	ehu
E. coruscans	red snapper	palu-loa	onaga	onaga
Lethrinus amboinensis	ambon emperor	filoa-gutumumu	mafuti/lililok	
L. rubrioperculatus	redgill emperor	filoa-pa'o'omumu	mafuti tatdong	
Lutjanus kasmira	blueline snapper	savane	sas/funai	ta'ape
Pristipomoides auricilla	yellowtail snapper	palu-i'usama	guihan boninas	yellowtail kalekale
P. filamentosus	pink snapper	palu-'ena'ena	guihan boninas	opakapaka
P. flavipinnis	yelloweye snapper	palu-sina	guihan boninas	yelloweye opakapaka
P. seiboldi	pink snapper		guihan boninas	kalekale
P. zonatus	snapper	palu-sega	guihan boninas/gindai	gindai
Pseudocaranx dentex	thicklip trevally		terakito	butaguchi/pig ulua
Seriola dumerili	amberjack		guihan tatdong	kahala
Variola louti	lunartail grouper	papa	bueli	
Seamount Groundfish:				
Beryx splendens	alfonsin			kinmedai (Japanese)
Hyperoglyphe japonica	ratfish/butterfish			medai (Jap.)
Pseudopentaceros richardsoni	armorhead			kusakari tsubodai (Jap.)

In Hawaii, changes in species catch composition are provided for the Main Hawaiian Islands (MHI) and the Northwestern Hawaiian Islands (NWHI). Statistical tests for consistency in catch composition over time and between areas are included. Where possible, descriptor information has been presented for each NWHI management zone: Hoomalu and Mau. For 1996, pounds landed by species are presented in tabular form for each area except Hawaii. For Hawaii, NWHI BMUS landings by species are provided for 1986 through 1996.

1.1.2 Effort information

Effort is measured in number of trips for Hawaii and the Northern Marianas, and in both hours fished and trips taken for American Samoa and Guam.

1.1.3 Participation information

Estimates of the number of vessels making bottomfish landings are provided for all areas.

1.1.4 Economic information

Time trends in economic performance are characterized by plots of total ex-vessel revenue, aggregate average price levels, and for Hawaii, price trends over time for major species. In time-series of prices and revenues, it is appropriate to adjust value for the rate of inflation so that values throughout the time period are comparable (based on a consistent purchasing power for the dollar). Both the unadjusted and adjusted aggregate average price and aggregate revenues are plotted to clarify the relative change over time.

1.2 Definition of Indicators

Indicators were developed as tools for identifying signs of stress in the stocks or the fishery which deserve further investigation and/or a management response. Analyses consider how the indicators change over time. Indicators for Hawaii include 95% confidence intervals. To the degree possible, similar variance estimates are expected from the other areas in future annual reports. The indicators are defined as follows:

1.2.1 Aggregate Catch-Per-Unit-Effort

If the current year's aggregate catch-per-unit-effort (CPUE) is less than 50% of the average aggregate CPUE for the first three years of available data, there may be cause for concern. CPUE information is available for all areas; research CPUE is available for SE Hancock Seamount for all years since 1985, except 1992, 1994, 1995 and 1996.

1.2.2 Mean Fish Size

If there has been a significant reduction in mean fish size for a species over time, the stock may be stressed by the fishery. Mean size information is provided for nine species in Hawaii.

No mean size information was available at this time for American Samoa, Guam or the Northern Marianas.

1.2.3 Percent Immature

If over 50% of the catch for a species is below the size of first maturity, the stock may be stressed by the fishery. Information for this indicator is available only from Hawaii.

1.2.4 Spawning Potential Ratio

The spawning potential ratio (SPR) is the ratio of the spawning stock biomass per recruit, at the current level of fishing, to the spawning stock biomass per recruit that would occur in the absence of fishing. According to the overfishing definition contained in the Bottomfish FMP (Amendment 3, 1990), if SPR is less than or equal to 0.20, recruitment overfishing has occurred (i.e., spawners have been reduced to 20%, or less, of their unexploited stock level). Data to calculate SPR were not available from Guam or the Northern Marianas. An estimate of the "worst case" SPR was calculated for American Samoa's bottomfish complex using Dory Project data to estimate the virgin population CPUE and information on percent of immature fish from Hawaii. In Hawaii, SPR was calculated for five major species in the Hoomalu and Mau Zones, of the NWHI, and the MHI; some SPR values changed slightly from previous year's reports due to improvement in the calculations. SPR for armorhead was calculated annually since 1985, except for 1992, 1994, 1995 and 1996.

1.2.5 Economic Indicators

Revenue per trip plots are presented for all areas except the MHI. A more valuable indicator for the commercial fisheries, which may be available in the future, would be net revenue (ex-vessel revenue minus costs per trip).

2.0 AREA SUMMARIES

2.1 American Samoa

2.1.1 Descriptors

Bottomfish landings, which declined from 1988 to 1992, rose slightly in 1993 and dramatically in 1994. The decline was attributed to the following: the three hurricanes that struck the territory (in 1987, 1990 and 1991), the departure of several highliners from the fishery, the shift in importance from bottomfishing to trolling, and the substitution of imported fish from Western Samoa and Tonga. The significantly greater 1994 total landings, when compared to the previous years, occurred primarily due to improved catch recording, an increase in effort by highline vessels, and a high fish demand for government and cultural events. The 1996 total landing increased 30% from the 1995 landings.

Fishing effort, measured by the number of trips, increased 50% in 1996. The increase in effort was primarily due to highliners increasing efficiency and hiring multiple crews. The total number of boats increased from 25 to 26 vessels.

The average price per pound increased in 1996 by 3% to $1.93. This increase is consistent with a general trend since 1991. Inflation-adjusted values have experienced fluctuations no greater than 11% from 1985-1994, with the 1994 average price near the high end of the range. Prices of locally caught fish were kept low due to the large amount of imports.

2.1.2 Indicators

CPUE (pounds per hour), relatively stable (at about 10 lb/hr) in the early 1990s, has increased the last four years (up 6% in 1996) indicating a healthy fishery. The proxy "worst case" SPR was 0.58 in 1996, indicating that recruitment overfishing has not occurred. Size and maturity data were collected from key species, but insufficient sample sizes were available for a more realistic SPR estimation. Bottomfish revenue per trip (as opposed to total revenue) decreased 6% in 1996 which is consistent over the long period.

2.1.3 Recommendations

Status of the 1995 recommendation: DMWR did not act on last years recommendation to continue collecting the appropriate data to obtain a more realistic SPR estimate for American Samoa's bottomfish complex.

1996 recommendation: **The Council assist DMWR in identifying funds to continue collecting appropriate data to improve the estimate of SPR for the bottomfish complex (as no progress was made on this recommendation over the past year).**

2.2 Guam

2.2.1 Descriptors

The fairly large fluctuations over time in bottomfish landings in Guam appear to be due more to entry and exit patterns of fishermen, rather than changes in fish stocks. The number of highliners fishing in the area doubled from 1993 to 1994, increasing the total commercial BMUS harvest and revenue by nearly 300% during that year. In 1996, the total BMUS landings increased by 24% and the total commercial BMUS harvest decreased 51% from 1995. Commercial landing continue to decrease due to departures of highliners from the fishery. The 1996 commercial landing represents the lowest level ever for commercial landing of BMUS, owing in large part to the almost complete absence of highliner activity.

Although the commerical BMUS landings decreased 51% in 1996, the total BMUS and bottomfish harvest increased 31% and 27%, respectively. This total increase is due primarily to an increase in recreational and subsistence-type boats participating in the fishery in 1995 and

1996. The 1995 total number of boat hours and trips increased nearly 175% due to the recreational and subsistence-type boats and the calm seas throughout most of 1995 which allowed many of them to participate in bottomfishing more often than usual. Overall, a high level of participation continued in 1996 with only a 5% drop in number of vessels and a 7% reduction in both boat hours and boat trips. The 1996 statistics are, however, representative of a general increasing trend which began in 1986.

The adjusted average price for bottomfish has not shown consistent marketing trends. This is believed to have resulted from the seasonal supply of pelagic fish and difficulties in developing a consistent market for locally caught fish. In addition, imported fish from other islands around the region have contributed to the continued marketing problem for local fishermen. The 1996 inflation-adjusted average bottomfish price of $2.66 is the lowest ever recorded and may explain why local highliners were almost completely absent from the bottomfish fishery this past year.

2.2.2 Indicators

In 1996, the CPUE has risen 44% over the 1995 all time low of 3.2 lb per hour. Based on an aggregate catch-per-unit-effort average of 6.9 lb/hr for the first three years of data collection on Guam, the 1996 figure removes the fishery from the 1995 "yellow light" situation which occurred for the first time. However, it is important to note that CPUE is affected considerably by the predominance of recreational and subsistence-type effort that does not target most of the BMUS species of primary concern.

The adjusted average revenue per trip does not appear to show any long-term trend or cause for concern. The substantial increases in both actual and inflation adjusted revenue per trip occurring in 1994 are best explained by the success of the highliner vessels. The 1995 increase in revenue for all species landed verses the decrease in revenue for bottomfish only, indicated that on average, most commercial fishermen continue to make more money from their trolling efforts than from bottomfishing.

2.2.3 Recommendations

Status of 1995 recommendations:

Action taken on recommendation 1a (below) to develop a customized computer software program to update, standardize and reprocess Guam's survey data resulted in DAWR working directly with the WPacFIN program coordinator to achieve this goal rather than hiring a private contractor. Efforts to achieve the above goals are presently ongoing. Action on recommendations 1b and 1c are pending completion of 1a.

No action was taken on recommendation 2 to complete a baseline biological survey of the red-gilled emperor (*Lethrinus rubrioperculatus*), and 3 to calculate mean fish size, percent immature and SPR for both the deep and shallowwater complexes, because it is still not clear where and how DAWR will acquire the assistance necessary for such research projects.

1996 Recommendations are carried over from 1995:

1) Recognizing that results derived from the spreadsheet format presently being used for Guam's BPT annual reports are not completely representative of the data analysis required by the Council, and that this deficiency continues to jeopardize confidence in the data presented in the Guam reports, every effort should be made to complete the state-of-the-art database computer program that will provide DAWR with the capability of integrating the offshore survey expansion data with the inshore survey expansion data, and additionally produce statistics of confidence, a compilation of biological data, and a complete species composition analysis. Specifically, to:

a. continue working directly with the WPacFIN program coordinator to complete a customized computer program that will update, standardize and reprocess the DAWR creel survey database as well as meet the Plan Team's annual reporting requirements;
b. provide necessary manpower for the immediate implementation, input and processing of the DAWR creel survey database from 1980 to present;
c. train designated DAWR staff to use the new software and to interface with NMFS/WPacFIN software to facilitate additional support in the processing and analysis of fisheries data if necessary.

2) The need to complete a baseline biological survey of the red-gilled emperor (*Lethrinus rubrioperculatus*) remains as the single most important data deficiency for the Marianas shallow-water bottomfish resource. Thus, the previous recommendations in the '92 through '96 Guam annual reports: **to establish a joint program with the CNMI continues to be a priority; especially in light of the fact that the window of opportunity to conduct such a project with the CNMI's virgin stocks is rapidly closing as commercial bottomfishing operations continue to grow in number and increase their fishing effort.**

3) **With the assistance of the National Marine Fisheries Service, calculate the mean fish size, percent immature and spawning potential ratio (SPR) indicators for Guam's deep *and* shallow-water bottomfish complexes.**

2.3 Hawaii

2.3.1 Descriptors

Main Hawaiian Islands: Only commercial data are available for both the MHI and NWHI fisheries, even though the MHI recreational/subsistence catch is estimated to be about equal that of commercial landings. In 1988, there was a dramatic increase in MHI bottomfish landings due to a bonanza uku (gray snapper) harvest. Since that time there has been a steady decline in total landings, which stabilized from 1990-1992. Landings in 1994 went up 32% over 1993 (which was the lowest recorded annual value), then rose slightly in 1995. Landing dropped to their all time low in 1996 recording only 421,000 pounds which represented a 26%

drop from 1995. This decrease in MHI landings for 1996 occurred with effort remaining similar to 1995 levels.

Total ex-vessel revenue from the MHI has shown a general decline from 1988-1996 with the inflation adjusted revenue of the MHI fishery being the lowest since 1974 and less than one third of what is was in 1988.

NWHI Mau Zone: Mau Zone 1996 landings have decreased 19% from 1995. The total number of boats increased from 10 to 13, while the number of trips decreasing by 16%. In addition to the decreased trips, bottomfish landings per trip decreased by 5%.

NWHI Hoomalu Zone: Hoomalu Zone 1996 landings decreased 13% from 1995. Three boats fished in the zone (two less than last year), which help account for the number of trips decreasing by 21%. In addition, bottomfish landings per trip decreased by 3% based on NMFS CPUE.

Available revenue data are not separated by zone. Overall NWHI inflation-adjusted revenue has been relatively stable since 1990. Inflation-adjusted average bottomfish price appears to be relatively stable in recent years.

2.3.2 Indicators

MHI: CPUE in 1996 continue to decreased to its lowest level on record at 176 lb/trip. Recent CPUE values are about one-forth the early (baseline 1948-50) values, signifying a continued yellow-light condition in the MHI. This indicator suggests that ehu is the most stressed species with a recent CPUE of only 11% that of the initial years of the fishery. The increase in the late 1980s MHI CPUE was primarily due to a large increase in uku catches, and may not indicate an increase in abundance in other species. Most of the more commercially important species in the MHI have had relatively stable mean weights since 1984. Hapuupuu's mean weight (which dropped sharply in 1993) rose in 1994 then dropped further in 1995 and continued to be low in 1996. It is the only species which shows a recent decline in mean weight, however, it should be noted that the sample size was small (only 2.5% of the catch) and a longer time series may be needed.

For the fourth year 95% confidence intervals were constructed based on "best" and "worst" case bounds of SPR components (CPUE and percent immature). For the second SPR values were calculated using both aggregate CPUE, as in previous years, and targeted CPUE which gives a more accurate picture for individual species. Of the five major species for which the SPR indicator was calculated using aggregate CPUE, onaga and opakapaka had values below the 0.20 "critical" level, indicative of recruitment overfishing, while uku, hapuupuu and ehu showed values approaching this level (SPR = 0.24, 0.21 and 0.23, respectively). The use of targeted CPUE showed a different picture for the four species where targeted trips are available. Here, onaga and ehu SPRs are much worse than indicated using aggregate CPUE (SPR = 0.05 and 0.08, respectively), whereas SPR values for opakapaka and uku are much higher than previously indicated (SPR = 0.28 and 0.45, respectively). Onaga's SPR has now

been below 0.20 for the past 8 years and ehu for the last 11 years (using targeted CPUE), indicating a red light situation for these species. Hapuupuu continued to show at 0.21 for the second year using aggregate CPUE and must also be considered in the red light condition.

NWHI Mau Zone: The NMFS CPUE data are only available for the NWHI fishery as a whole since 1984 and by zone since 1988. The NWHI (combined Mau and Hoomalu Zones) NMFS CPUE steadily decreased from 1987 to 1992, rose in 1993, and then dropped to an all-time low of 407 lb/day in 1996, which is 55% of the average of the first 3 years (739 lb/day, 1984-86). This could be the result of a return to normal abundance, rather than a decrease in normal fish abundance; but it could also represent declines in some stocks. The reasons are currently unclear. The Mau Zone NMFS CPUE had been steadily decreasing since 1989, but increased in 1993 and 1994 to 353 lb/day, for reasons unknown. In 1995 and 1996, NMFS CPUE declined slightly to 298 lb/day. The Mau Zone HDAR CPUE increased 17% from 1995, with the 1996 value only 49% of the average of the first three years (5,911 lb/trip, 1948-50), indicating a yellow light condition. Non-parametric 95% confidence intervals were calculated for HDAR CPUEs by the "bootstrapping" method. Mean weights of fish in the Mau Zone continue to exhibit year to year fluctuations, but are generally at much higher values than MHI mean weights. The percent of immature fish in the 1993 Mau Zone catch was still safely under 50% for all species evaluated.

The SPR values in the Mau Zone had been decreasing since 1990 (mirroring the pattern in the HDAR CPUE) but experienced a surprising rise in 1994 and returned to lower levels in 1995 with a slight increase in 1996. All values are presently above 0.50, well above the critical level of 0.20. SPR values are higher in the NWHI than the MHI because most of the catch is mature fish. SPR values in both NWHI zones have never fallen below 0.35.

NWHI Hoomalu Zone: The Hoomalu Zone NMFS CPUE has been on a downward trend since 1988, reaching its lowest point in 1996. The Hoomalu Zone HDAR CPUE followed an increasing trend, but dropped sharply in 1994 for unclear reasons and rose by 20% in 1995 and remained similar in 1996. The 5,588 lb/trip was 66% of the average of the first three years (8,440 lb/trip, 1948-50). Mean weights of fish in the Hoomalu Zone continued to exhibit year to year fluctuations, but are still at much higher values than MHI mean weights. The percent of immature fish in the 1996 catch was still safely under 50% for all species evaluated.

The SPR values in the Hoomalu Zone increased in 1995, with four of the five measured species showing values of 0.77, while onaga had an SPR value of 0.56.

Seamount Groundfish (Armorhead): No fishing has been allowed on the armorhead stocks of the SE Hancock Seamount since the moratorium began in August, 1986. The 1993 CPUE, calculated from research longline catches, was more than double that of the last assessment (in 1991) and nearly as high as the highest CPUE recorded since surveying began in 1985. No research cruise occurred in 1994, 1995, or 1996 and future research assessment cruises are unlikely.

No SPR values were available in 1996 as no research was undertaken. In 1993, SPR within the EEZ (SE Hancock Seamount) was above 0.02, the highest since 1986, but still far below (10% of) the threshold level for recruitment overfishing of 0.20. About 99% of the known armorhead seamount habitat occurs outside the U.S. EEZ, an area which had 0.06 SPR in 1993. During February and March 1997, an oceanic and larval armorhead survey over the seamounts outside the U.S. EEZ was conducted onboard the R/V Kaiyo Maru by the National Research Institute of Far Seas Fisheries Laboratory in Shimizu, Japan. Armorhead larvae were collected from surface waters around all seamounts except for Koko Seamount.

2.3.3 Recommendations

1) The BPT reiterates its concern regarding the continuing overfished condition of the MHI onaga and ehu stocks as it adds hapuupuu to the list. The Team recommends continued support for the ongoing efforts of the DLNR bottomfish task force toward establishing effective management regulations for the MHI fishery.

2) Again, the BPT strongly encourages the State to proceed expeditiously with computerization of the fish and seafood dealer reporting system and integrate this with the fishermen's commercial catch reporting system.

3) The BPT encourages NMFS and the State to increase the level of bottomfish catch monitoring of the Honolulu auction and expand this sampling to major dealers on all other main Hawaiian Islands.

2.4 Northern Mariana Islands

2.4.1 Descriptors

Data are available only on the commercial fishery. The declining trend in landings and revenues, which occurred from 1988-91, was reversed by a growth trend which began in 1992. Bottomfish landings in 1995 went up 42% over 1994 and 96% over 1993, due primarily to the growth of the local bottomfishing industry, particularly from new ventures operating full time. The number of vessels fishing increased 112% in 1996 to 70. The 1994 increase was in vessels of all sizes, including large (50 ft plus) vessels. The number of trips increased 44%, reaching the highest level since 1984. Increased fishing trips is attributed to more full time operations conducting regularly scheduled long trips to the northern islands, where bottomfish are more abundant.

The average adjusted price per pound received for bottomfish decreased (3%) to $3.34. The decrease in 1995 occurred due to inflation adjustments. The total 1996 ex-vessel revenue increased 84% to $176,707. The increase is attributed to expanded bottomfish operations, particularly from one full time-full year fishing venture operation.

2.4.2 Indicators

The average bottomfish catch per trip increased 28% over 1995. The average catch per trip is subject to significant biases (e.g., changes in trip length and relative amounts of bottomfishing compared to trolling). It may be possible to improve this measure of CPUE by using only those trips which landed bottomfish species exclusively. While such a calculation may be sensitive to other biases due to small sample size, it should be investigated in the future. This indicator does not suggest the need for any management action.

Although bottomfish effort and landings are increasing, revenue obtained from bottomfish sales remain relatively stable. The average revenue per bottomfish trip increased 38% for bottomfish species and slighltly for all species. All species inflation adjusted revenue, which had been declining since 1988, appears to have not stabilized at this point. Bottomfish fisherman often troll to and from the bottomfishing site, thus acquiring a mixed catch after spending the day "bottomfishing".

2.4.3 Recommendations

1) The DFW should establish an ongoing bottomfish monitoring program to provide needed data for the commercial bottomfish fishery, and requests that the Council assist DFW in obtaining funds to implement and maintain the program, and requests that NMFS/WPacFIN assist in designing and implementing the program.

2) With assistance from NMFS, the DFW should establish baseline (virgin stock) parameters (CPUE, percent immature) for the Guam/CNMI deep-water bottomfish complex by using data collected during the NMFS Resource Assessment Investigation of the Marianas Archipelago (RAIOMA) cruises (1981-84), data from the current fishing in the northern islands, and sampling aboard DFW research vessel to help calculate SPR.

3) With assistance for NMFS/WPacFIN, software should be developed and implemented to separate fishery statistics for the main islands fishery from the northern islands fishery and that separate descriptions and statistics should be reported in the annual report module.

4) Establish baseline (virgin stock) parameters (CPUE, percent immature) for the Guam/Northern Marianas shallow-water bottomfish complex (e.g.,red-gilled emperor) by sampling program aboard DFW research vessel to help calculate SPR, with assistance from NMFS.

2.5 Region-Wide Recommendations *(as revised at May 1997 BPT meeting)*

1) **The BPT concurs with the urgency of the recommendations in the NMI and Guam modules to establish baseline parameters of the virgin stock for the shallow-water and deep-water bottomfish complexes.** The establishment of the baseline parameters is essential, since now is the only opportunity due to the rapidly expanding northern islands' fishery.

2) The BPT recognizes that the American Samoa, Guam, and NMI bottomfish fisheries are comprised of two separate species complexes (the shallow-water emperor based and deep-water eteline/grouper based complexes) that should be analyzed separately. **The Team recommends that the NMFS Honolulu Laboratory staff continue to development of methodology for the collection and analysis of appropriate data (i.e., virgin population catch rates, size at maturity, percent immature, and SPR values) and provide assistance to the respective areas.**

3) The BPT reviewed the current BMUS list and found many shallow-water species from American Samoa, Guam and the Northern Mariana Islands are not included but should be the included in the BMUS list. **To incorporate these species to the BMUS, the BPT recommends expanding the BMUS list to include generic designations.**

4) **The BPT concurs with the area specific recommendations presented in the annual report modules for American Samoa, Guam, Hawaii and the NMI (as detailed in the report summarized above).**

Appendix 1

American Samoa

CONTENTS

page

Summary 1-2

Historical Annual Statistics 1-3

List of Tables 1-4

List of Figures 1-4

Introduction 1-5

Recommendations 1-5

Tables 1-6

Figures 1-10

Summary

During 1996, a total of 26 local boats landed an estimated 39,500 pounds of bottomfish in the territory. Revenue for the domestic commercial fishery this year was estimated around $74,500, with all the catch being sold locally.

The fishery was relatively bigger between 1982 and 1986 than in recent years (Fig. 1). This observation reflects a trend in the loss of skilled and full-time commercial fishermen from the fishery, depletion of newly discovered banks (mainly the 2% Bank), the shift of preference from bottomfishing to trolling and, recently, the diversion of effort by the commercial bottomfishermen to do longlining. The December 1991 hurricane contributed to the 1992 decrease in landings (Fig. 1) and the second lowest number of trips ever recorded (Fig. 3). Compared to the 1982-1986 period, the past two years' landings, effort and subsequently revenues were notably less. This is mainly due to the highliners' diverting their efforts towards the more profitable longlining method.

The CPUE in 1996 (17.5 lbs/hr) was greater than the estimated baseline CPUE (14.8 lbs/hr) indicating no signs of stress in this fishery. The proxy "estimate of the worst case" SPR (refer to the analysis in Fig. 7) indicated that recruitment overfishing is not occurring in this fishery. Currently available data do not indicate any serious problems with the stocks.

A few annual summaries, dating back to 1982, is provided on the next page to provide the users with a general snapshot of the history of American Samoa's bottomfish fishery.

Historical Annual Statistics

Years	Total Landings (lbs) all Bottomfish	CPUE (Lbs/trip.hr)	Inflation adjusted Revenues($)	Bottomfish $/Lb	Number of Boats
1982	64942	8.5	173359	1.83	27
1983	126327	10.0	407123	2.15	38
1984	94104	10.7	247872	1.80	48
1985	104675	8.1	208138	1.38	47
1986	98361	9.6	206112	1.48	34
1987	30640	12.5	63476	1.54	20
1988	64530	19.7	131615	1.61	26
1989	48137	15.3	71557	1.51	29
1990	15445	10.2	27261	1.66	19
1991	17917	10.0	33178	1.81	20
1992	13715	10.5	29700	2.01	14
1993	17098	11.4	31521	1.81	23
1994	39533	13.1	84388	2.03	21
1995	30503	16.5	58425	1.88	25
1996	**39501**	**17.5**	**74503**	**1.93**	**26**
Averages	53695.2	12.24	123215.2	1.762	27.8
St.Deviation	36770.9	3.49	107435.71	0.225	9.98

Tables

page

1. American Samoa 1996 Estimated Total Bottomfish Landings 1-6

2. American Samoa 1996 Estimated Average Price of Bottomfish Species 1-8

Figures

page

1. American Samoa Bottomfish Landings 1-10

2. American Samoa annual estimated commercial bottomfish landings 1-12

3. American Samoa annual estimated bottomfish hours and trips 1-14

4. American Samoa annual estimated number of boats landing bottomfish 1-16

5. American Samoa average price of bottomfish 1-18

6. American Samoa annual bottomfish CPUE 1-20

7. American Samoa annual estimated spawning potential ratio for bottomfish complex 1-22

8. American Samoa average inflation-adjusted revenue per trip landing bottomfish 1-24

Introduction

Bottomfishing from canoes by the natives of the American Samoa islands has been a subsistence traditional practice in the distant past. But it was not until the early 1970s that the bottomfish fishery developed into a commercial venture utilizing motorized boats. A government subsidized program, called the Dory Project, was initiated in 1972 to develop the offshore fisheries into a commercial venture, and resulted in an abrupt increase in the fishing fleet and total landings. In 1982 a fisheries development project aimed at exporting high-priced deep water snappers to the Hawaii fish auction caused another notable increase in both bottomfish landings and revenue. Between 1982 and 1988, the bottomfish fishery comprised as much as 50% of the total commercial catch. Since 1988 the nature of American Samoa's fisheries has changed dramatically with a shift in importance from bottomfish fishing towards trolling.

During the early 1980s data were collected for the bottomfish fishery by interviewing only commercial vessels. In the current Offshore Creel Survey on Tutuila that started in October 1985, commercial, subsistence and recreational domestic boats landing catches in five designated areas were interviewed and their catches examined. For two weekdays and one weekend day per week, DMWR data collectors sampled offshore fishermen between 0500 and 2100 hours. Two DMWR samplers based on Tau and Ofu collect fisheries data from the Manu'a Islands fleet.

Boat-based fishing in Tutuila and Manu'a used to be just trolling and/or bottomfishing. Last year and again this year, record longline landings (mainly by the Alia commercial fishermen) was recorded. The bottomfish fishery of American Samoa is typically commercial overnight jigging using skipjack as bait, on 28-foot aluminum Alias. Bottomfish imported mainly from the neighboring independent state of Western Samoa has assisted in satisfying the high demand for fresh fish that cannot be supplied by the small local commercial fleet. The adverse effects of three hurricanes that struck American Samoa in 1987, 1990 and 1991 can be seen in some of the trends in the fishery as depicted by the data in this report.

Recommendations

Status of the 1995 recommendation:

DMWR didn't act on last years recommendation to continue collecting the appropriate data to obtain a more realistic SPR estimate for American Samoa's bottomfish complex.

1996 recommendation:

The Council may want to assist DMWR in identifying funds to continue this project.

Table 1. American Samoa 1996 Estimated Total Bottomfish Landings

Species	Pounds
Redgill Emperor	1748
Ambon Emperor	866
Longnose Emperor	3580
Orangespot Emperor	1340
Emperors (misc)	3616
Tomato Grouper	258
Yellowspotted Grouper	19
Peacock Grouper	398
Lunartail Grouper	1491
Blacktip Grouper	107
S/tooth Grouper(E.microdon)	15
Grouper (misc)	854
Bluelined Snapper	3625
Stone's Snapper	232
Onespot Snapper	210
Yelloweye Opakapaka	1197
Gindai	461
Gray Jobfish	3496
Onaga	3639
Ehu	2761
Humpback Snapper	886
Twinspot/red Snapper	172
Hawaiian opakapaka	183
Lehi	3403
Trevally-C.caeruleop	146
Bottomfish (assorted)	1730
Amberjack	82
Black Jack	1246
Jacks (misc)	1739
Total Bottomfish	**39501**
Total BMUS	**32245**

Interpretation: The appearance of new species in recent years (e.g. ***Epinephelus microdon*** appearing this year) was due to the improved identification of various species by DMWR

samplers. These species were occasionally present in landings from previous years, but were not identified at the species level.

Source: DMWR Offshore Creel Survey database

Calculation: Catches are weighed by species either at landing sites or during the selling of fish to dealers. Data on landings sold to stores on non-sampling days and a few trips missed by samplers on sampling days are accounted for in a separate Data Collection System - the Invoice Purchase System. The above analysis is from the Offshore Creel Survey data only. Analyses of American Samoa's bottomfish data are for the whole complex, not just for BMUS.

Table 2. American Samoa 1996 Estimated Average Price of Bottomfish Species

Species	Ave. Price ($/lb)
Redgill Emperor	1.85
Ambon Emperor	1.89
Longnose Emperor	1.87
Orangespot Emperor	1.85
Emperors (misc)	1.91
Tomato Grouper	1.85
Yellowspotted Grouper	1.85
Peacock Grouper	1.87
Lyretail Grouper	1.91
S/tooth Grouper(*E.microdon*)	1.90
Blacktip Grouper	1.98
Tomato Grouper	1.98
Groupers (misc)	1.89
Pristipomoides/Etelis	1.50
Blueline Snapper	1.88
Stone's Snapper	2.00
Onespot Snapper	1.75
Opakapaka	1.96
Gindai	1.98
Gray Jobfish	1.91
Onaga	2.08
Ehu	2.09
Humpback Snapper	1.90
Twinspot/red Snapper	2.00
Hawaiian Opakapaka	1.79
Lehi	2.00
Trevally	1.93
Bottomfish (assorted)	1.90
Amberjack	2.00
Black Jack	1.89
Jacks (misc)	1.87
Total Bottomfish	**1.93**
Total BMUS	**1.95**

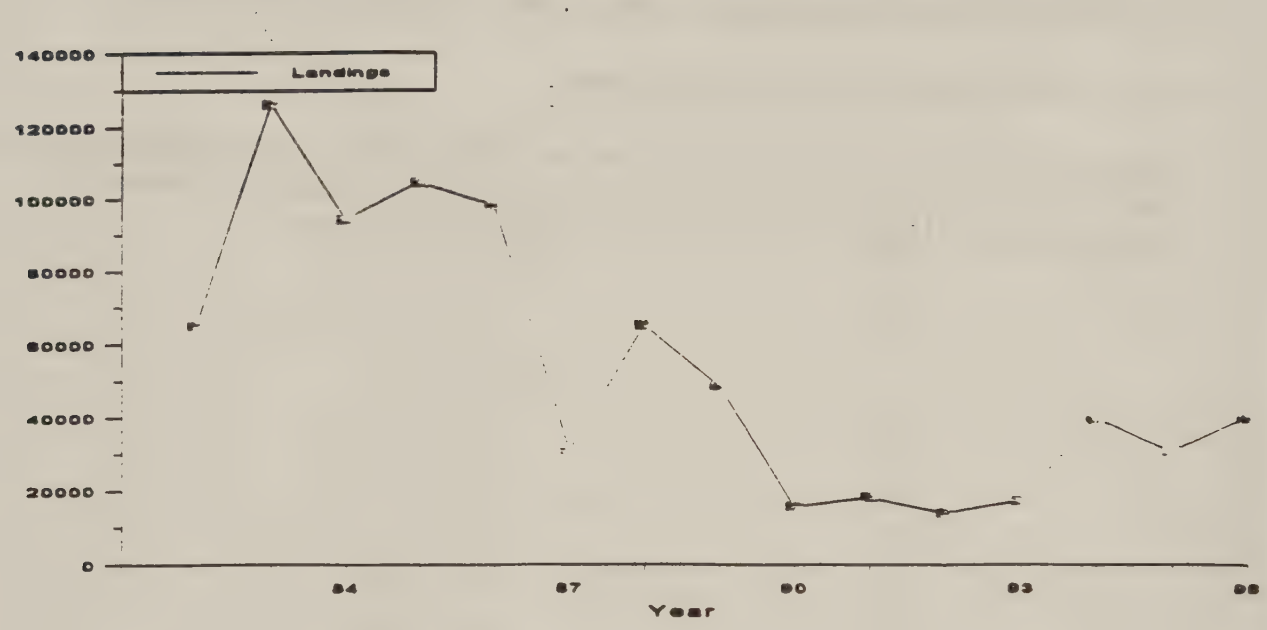
Interpretation: There appears to be no profound changes in the prices of individual species in the past five years. DMWR keeps track of imported bottomfish through a separate Commercial Invoice System. Data from that system reveals that since 1992, the average price of

bottomfish imported from Western Samoa were lower than for locally-caught bottomfish. Locally-caught bottomfish are of much superior quality and demands higher prices.

Source: DMWR Offshore Creel Survey database

Calculation: During creel surveys, the disposition of the catch is recorded, and if sold, the price is obtained whenever possible. The average prices reported in this table are calculated by dividing the total revenue by the weight sold in pounds for each species.

Figure 1. American Samoa bottomfish landings



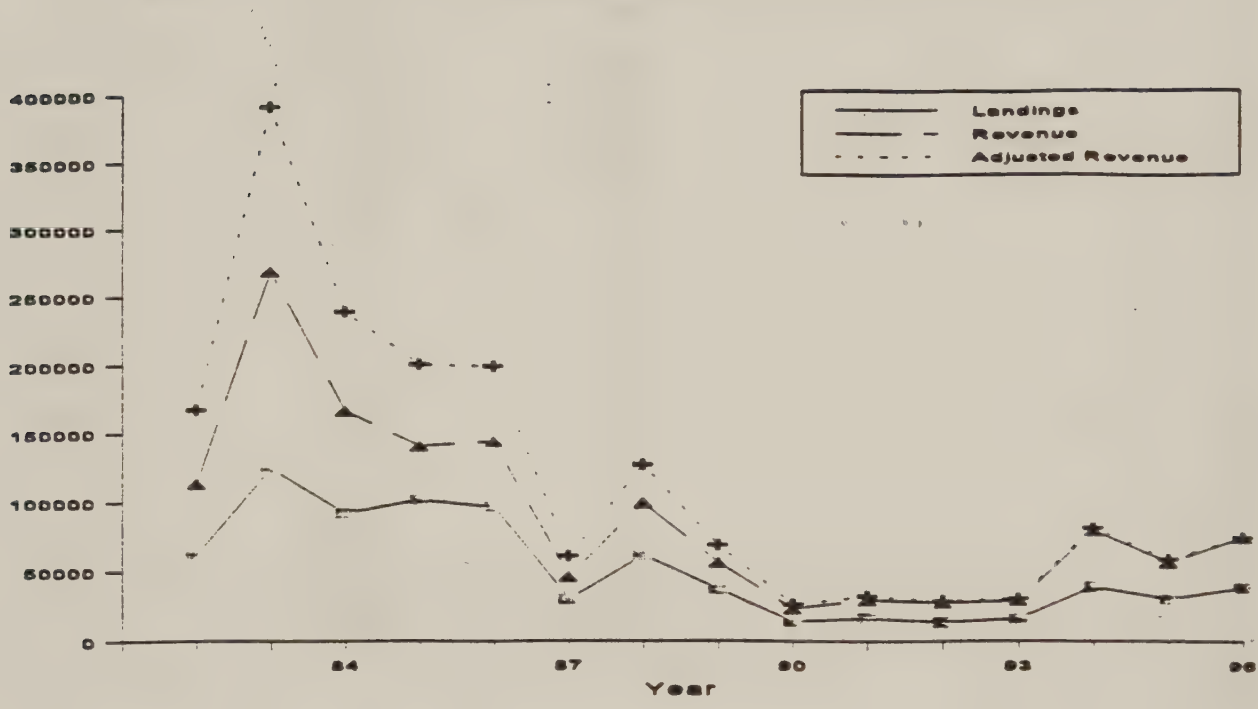
Interpretation: The substantial declines in landings in 1987 and 1990 were partially due to vessel losses caused by two hurricanes. Boat repairs were delayed as fishermen repaired or rebuilt their houses. In terms of total landings, the bottomfish fishery is much smaller in recent years than it was any time between 1982 and 1986, a period when there was a relatively large fleet and fishermen were attracted to the then profitable bottomfish export program. The increase in 1994 was due primarily to improved sampling on Tutuila and increased efforts by the Tutuila highliners. Furthermore, the Manua landings more than tripled due to social/cultural events during that year. Additional boats entering the fishery added to the total landings this year.

Source: DMWR Offshore Creel Survey database

Calculation: Bottomfish landings for 1982-84 are calculated by adjusting the sampled Tutuila data by the calculated annual percent coverage of the fleet, and then adding the similarly adjusted Manu'a landings. The 1986-present landings are from the creel survey expanded species composition files (*.SPC) which contain the annual estimated total landings by species for Tutuila, and then adding the adjusted Manu'a landings. Calculating statistics for 1985 is more complicated because the sampling program changed from commercial fleet sampling only to creel sampling on October 1, 1985.

Year	Landings (lb)
1982	64942
1983	126327
1984	94104
1985	104675
1986	98361
1987	30640
1988	64530
1989	48137
1990	15445
1991	17917
1992	13715
1993	17098
1994	39533
1995	30503
1996	39501
Average	53,695
Standard Deviation	36,771

Figure 2. American Samoa annual estimated commercial bottomfish landings.



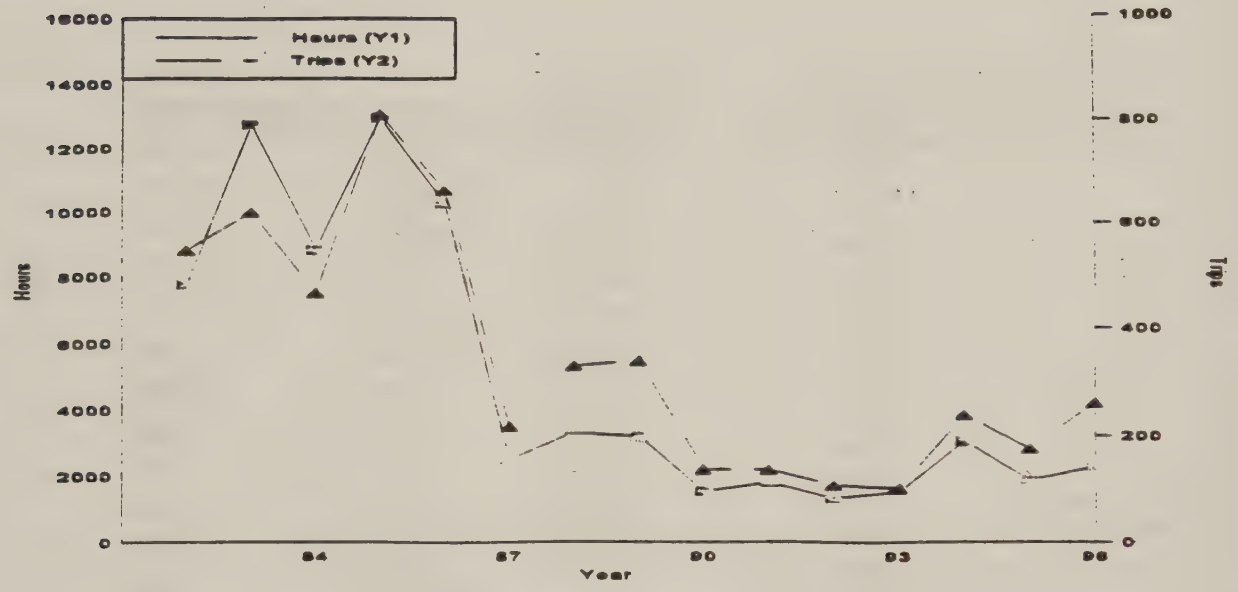
Interpretation: Commercial landings mirror the total fishery's declining catches in recent years. Relative to total landings, commercial landings decreased even more substantially in 1989, because the percent of the catch sold by bottomfish fishermen dropped from an average of about 97% in 1982-88 to 78% in 1989. The peak in 1983 portrays the high prices of deep water snappers exported to Hawaii, while the trough in 1987 can be attributed to effects of the 1987 hurricane. The December 1991 hurricane contributed largely to the decreased landings and subsequently a decrease in revenues in 1992. Unfavorable weather continued through May 1992 hindering commercial bottomfish trips. Increased efforts in 1994 produced a notable increase in revenues. No major changes in the commercial catches were recorded in the past two years.

Source: DMWR Offshore Creel Survey database

Calculation: A relatively complex set of algorithms are used to estimate the commercial landings from estimates of total landings created by the creel survey data expansion system. In short, the percent sold by fishing method is calculated monthly and multiplied by the percent species composition by month, then multiplied by the estimated total landings for that method and month. For 1982-85 sampling was conducted on the commercial fleet only (which included nearly all the fishing boats), whereas since 1985 creel sampling has covered all boats (commercial and recreational). Analysis of creel data for 1986-87 indicates that over 98% of the landed bottomfish were being sold. Therefore, it is believed to be valid to compare commercial data for years prior to 1986 to creel survey totals for years since 1986.

Year	Commercial Landings	Revenues	Inflation-Adjusted Revenues
1982	62,016	113,678	167,107
1983	125,167	269,083	392,323
1984	92,841	166,917	238,858
1985	102,670	141,495	200,639
1986	97,540	144,742	198,730
1987	30,236	46,537	61,196
1988	61,897	99,482	126,840
1989	37,438	56,433	68,961
1990	13,992	23,161	26,265
1991	16,296	29,439	31,971
1992	13,663	27,450	28,630
1993	16,146	29,160	30,384
1994	39,126	79,536	81,286
1995	30,010	56,340	56,340
1996	38,537	74,503	74,503
Average	51,838	90,530	118,936
Standard Deviation	36,695	67,891	103,453

Figure 3. American Samoa annual estimated bottomfish hours and trips



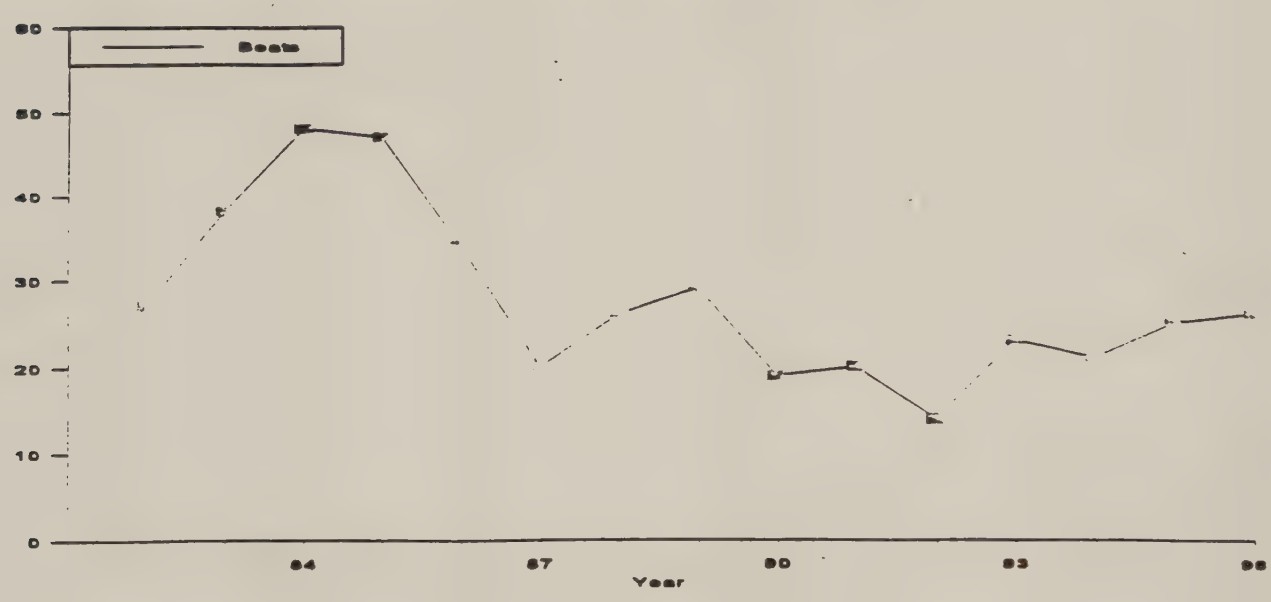
Interpretation: The sharp decline in the bottomfish landings since 1986, noted in Fig. 1 is mirrored in this figure by a sharp decline in the level of effort expended in that fishery. Rather than indicating a problem with the resource, this decline depicts an actual trend of commercial boat owners and fishermen seeking other more lucrative and stable lines of work. The noticeable increase in effort last year is primarily due to improved sampling, increased effort by the Tutuila highliners and the significant (about tripled) increase in effort by the Manua fleet. The bottomfish highliners diverted part of the effort to do longlining efforts in 1994 and contributed to the decrease in bottomfish trips and effort. The 1994-1996 estimated efforts were greater than those for the 1990-93 period due to the highliners increased efforts, with some boat owners employing teams (usually 2-3 fishermen) in continuous shifts during good weather.

Source: DMWR Offshore Creel Survey database

Calculation: The annual estimated effort (hours) spent bottomfish fishing is calculated by dividing the annual estimated total bottomfish catch by the average CPUE (pounds per hour) from trips doing only bottomfish fishing. The annual estimated number of trips is calculated by dividing the estimated annual hours by the average length of a bottomfish fishing trip. The average length of a bottomfish fishing trip (not shown) is calculated by using only trips which exclusively bottomfished and for which the trip length was recorded. The total hours fished from those trips is then divided by the number of trips. Recorded hours are trip hours.

Year	Hours	Trips
1982	7,671	548
1983	12,695	621
1984	8,796	468
1985	12,933	816
1986	10,255	666
1987	2,458	217
1988	3,281	330
1989	3,141	340
1990	1,514	136
1991	1,797	136
1992	1,312	107
1993	1,494	100
1994	3,017	238
1995	1,848	175
1996	2,263	262
Average	4,965	344
Standard Deviation	4,258	228

Figure 4. American Samoa annual estimated number of boats landing bottomfish



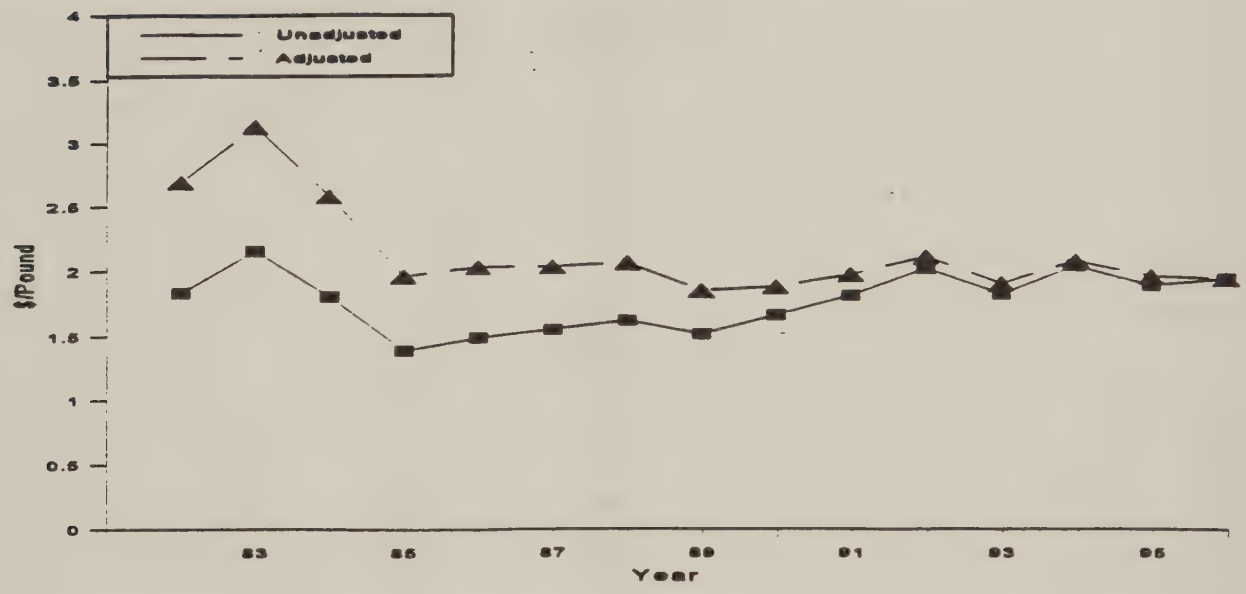
Interpretation: Again, the decline in the fishery since 1985-86 is noted by a decline in the number of boats participating in it. The 1987 hurricane caused the loss of the whole Manu'a fleet, plus some of the Tutuila fleet. Several boats which contributed to the 1989 bottomfish annual landings did not land any bottomfish in 1990, due to much needed repairs and their participation in non-bottomfish chartered trips. About 90% of the domestic fishing fleet was affected by the December 1991 hurricane, hence the decline in 1992. The increase in 1993 is due mainly to the re-entry to the fishery of a few vessels after repairs, trips by two 14-foot vessels that did not bottomfish in 1992, and the entry of one new alia into the sampling area. A few new Alias were bought from Western Samoa and entered the fishery in the past two years. In December this year, a new local company launched its first locally-made aluminum alia in American Samoa.

Source: DMWR Offshore Creel Survey database

Calculation: The annual estimate of the number of boats in the bottomfish fishery is obtained from the data base by counting the unique boats sampled during the year which landed any bottomfish species.

Year	Boats
1982	27
1983	38
1984	48
1985	47
1986	34
1987	20
1988	26
1989	29
1990	19
1991	20
1992	14
1993	23
1994	21
1995	25
1996	26
Average	28
Standard Deviation	10

Figure 5. American Samoa average price of bottomfish



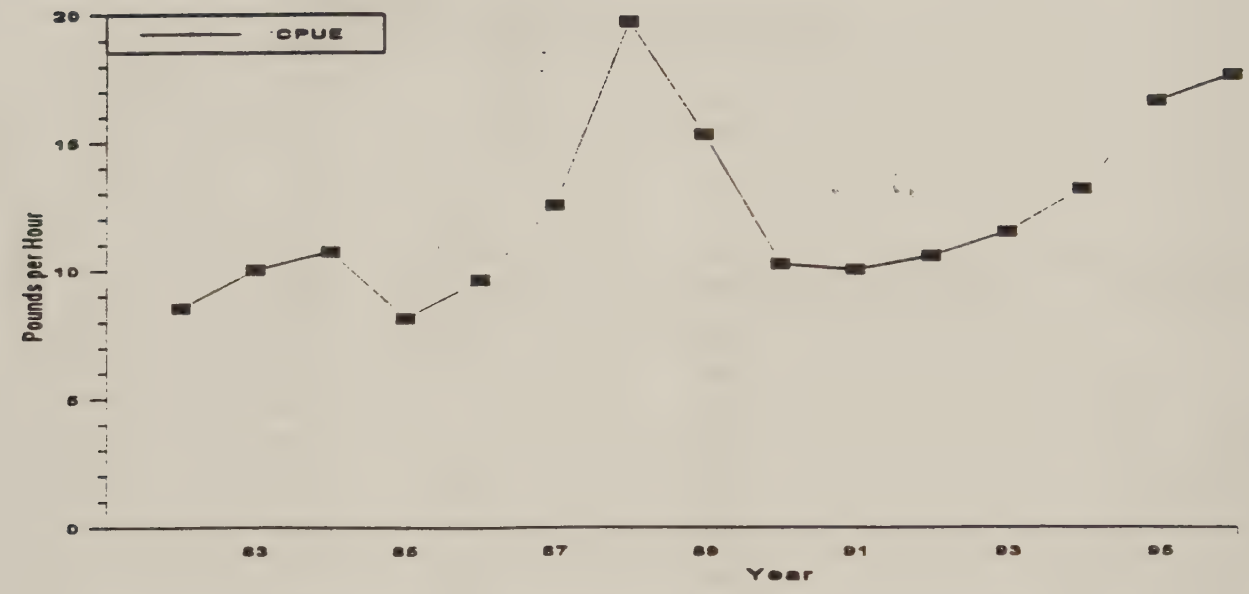
Interpretation: Prices were generally higher between 1982 and 1984 during the exportation of high-priced deepwXter snappers to Hawaii. After this period, inflation-adjusted local prices have generally been stable. Prices of locally-caught bottomfish are generally higher than imported fish, and could have been even higher had the local markets not been flooded by imported fish, which are generally of lower quality. The only imported bottomfish in 1994 were from Western Samoa and these were sold at an average price of $1.67/lb. Imported bottomfish (mainly from Western Samoa) have always helped in meeting the demand for bottomfish.[fish import statistics are not part of this analysis]. Prices have generally been stable in the past four years.

Source: DMWR Offshore Creel Survey database

Calculation: The average price of all bottomfish species combined is calculated by dividing total bottomfish revenue by total sold weight. The inflation adjusted price is calculated by multiplying the unadjusted annual average price by the annually calculated consumer price index (CPI) for American Samoa using the current year as the base. The 1996 CPI was 152.5.

Year	$/lb	Inflation-Adjusted $/lb
1982	1.83	2.79
1983	2.15	3.25
1984	1.80	2.67
1985	1.38	2.03
1986	1.48	2.11
1987	1.54	2.10
1988	1.61	2.13
1989	1.51	1.91
1990	1.66	1.95
1991	1.81	2.04
1992	2.01	2.17
1993	1.81	1.96
1994	2.03	2.15
1995	1.88	1.95
1996	**1.93**	**1.93**
Average	1.76	2.21
Standard Deviation	0.23	0.39

Figure 6. American Samoa annual bottomfish CPUE



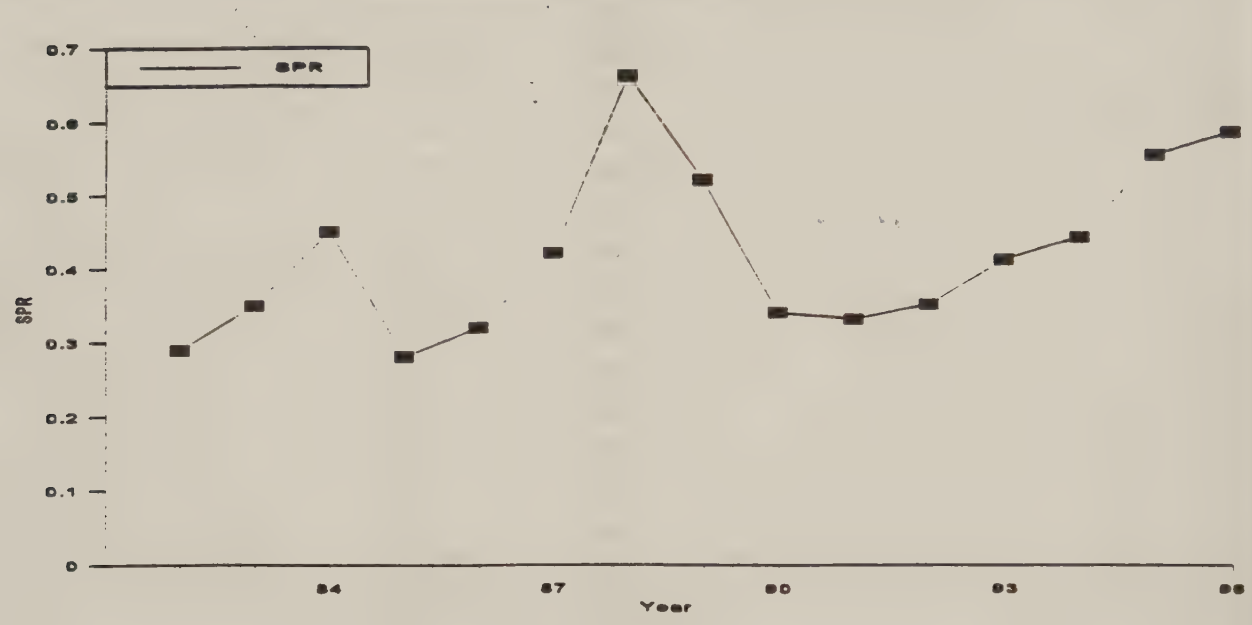
Interpretation: The initial high CPUE in 1983 and 1984 occurred during the intense fishing of some new fishing grounds for deepwater snappers exported to the more lucrative Hawaii auction. A relatively high number of boats and local commercial fishermen participated in the fishery during this period. The drop in 1985 and 1986 might be expected following the ardent harvesting of the limited fishing grounds. Reasons for the CPUE peak in 1988-89 are unknown. The decline in CPUE from 1989 to 1991 can be partially attributed to a combination of some new, inexperienced fishermen entering the fishery and the exit of experienced and full-time commercial fishermen. CPUE has essentially remained stable during 1990 to 1992, and has increased since then. Bottomfishing techniques and gear have generally remained the same in the past years with the Alias being the highliners since the early '70s. The past two year's high CPUE estimates (and most probably the 1988-89 CPUE increase) can be attributed mainly to improved sampling and not necessarily related to the status of the stocks.

Source: DMWR Offshore Creel Survey database

Calculation: CPUE (pounds per trip.hours) is calculated using only trips in which only bottomfish method was used and trip hours was recorded. The average is calculated by using each CPUE from each trip as an observation and dividing by the number of trips.

Year	CPUE
1982	8.5
1983	10.0
1984	10.7
1985	8.1
1986	9.6
1987	12.5
1988	19.7
1989	15.3
1990	10.2
1991	10.0
1992	10.5
1993	11.4
1994	13.1
1995	16.5
1996	17.5
Average	12.6
Standard Deviation	3.6

Figure 7. American Samoa annual estimated spawning potential ratio for bottomfish complex



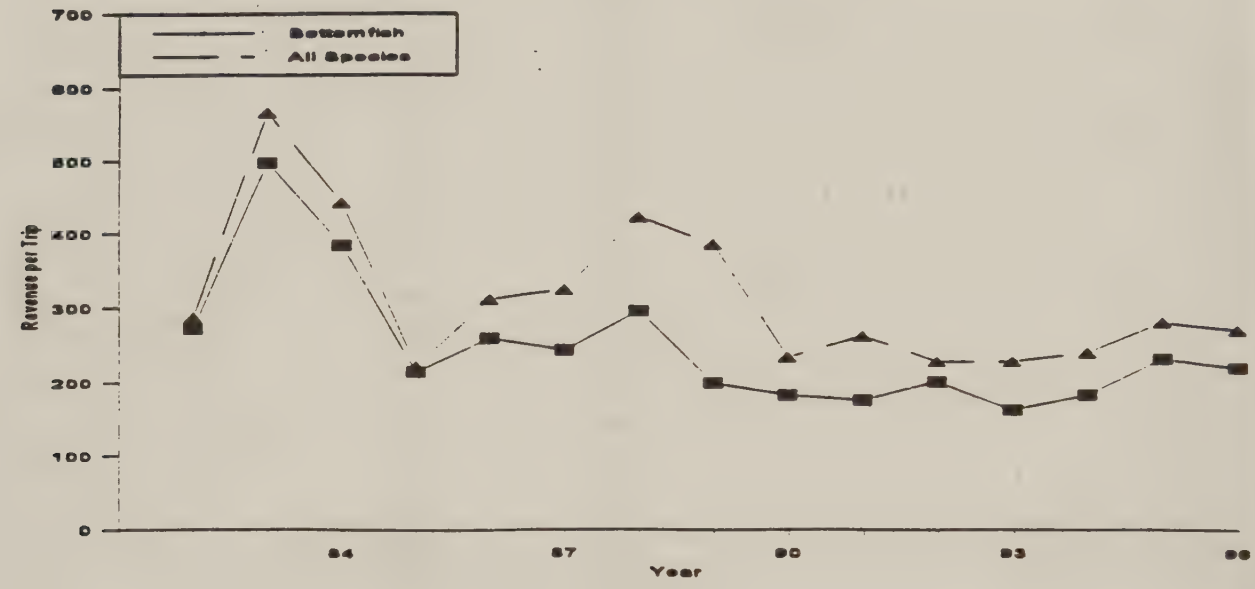
Interpretation: The proxy "worst case" SPR for 1996 was 0.58, substantially above the 0.20 critical level. According to this indicator, the bottomfish complex of American Samoa is not considered to be recruitment overfished. This year's SPR estimate **[refer to Calculations below]** increased with this year's increase in CPUE.

Source: DMWR Offshore Creel Survey database

Calculation: The spawning potential ratio is calculated by dividing the current year's CPUE by the virgin population CPUE, and then multiplying by the ratio of the current percent mature to the virgin population percent mature fish in the catch. To estimate SPR for American Samoa, the "Dory" project mean CPUE (refer to 1990 annual report page 20, Table 3) was used to estimate virgin population CPUE (14.8 lb/hr). Since size and maturity data available for bottomfish in American Samoa are insufficient, the ratio of percent mature in the local catch was estimated by substituting with the average (% mature) of the 5 species which have the lowest SPR in Hawaii (in 1991). In this manner a "worst case" SPR was calculated to provide what should be a very conservative estimate of SPR for the American Samoa bottomfish complex.

Year	SPR
1982	0.29
1983	0.35
1984	0.45
1985	0.28
1986	0.32
1987	0.42
1988	0.66
1989	0.52
1990	0.34
1991	0.33
1992	0.35
1993	0.41
1994	0.44
1995	0.55
1996	0.58
Average	0.42
Standard Deviation	0.11

Figure 8. American Samoa average inflation-adjusted revenue per trip landing bottomfish



Interpretation: No notable changes in revenues since 1990. The distance between these two lines reflects the relative importance of bottomfish species in the total catch whenever any bottomfish are landed. The prominent importance of bottomfish between 1982 and 1985 occurred during the targeting of deepwater snappers for export. Bottomfish fishing was also the more profitable method of fishing during that period. The relative importance of bottomfish has generally been declining since 1985 as most of the full-time commercial fishermen quit the fisheries. The supply of locally caught bottomfish has been supplemented by bottomfish imported from Western Samoa. Revenues have increased steadily since 1992 but slightly dropped this year.

Source: DMWR Offshore Creel Survey database

Calculation: The average revenue per trip for all species is calculated by summing the revenue of all sales for any trip which landed any bottomfish species, and dividing by the number of trips. The average bottomfish revenue per trip is calculated from those same trips by summing the sales of only bottomfish species and dividing by the number of trips. Figure 8 plots the inflation adjusted bottomfish and all species revenues per trip for the period 1982-94.

	Bottomfish $/Trip		All Species $/Trip	
Year	Unadjusted	Adjusted	Unadjusted	Adjusted
1982	185	282	196	298
1983	341	516	388	588
1984	269	399	309	459
1985	151	222	157	231
1986	189	269	226	322
1987	184	251	246	335
1988	231	305	331	437
1989	162	205	315	400
1990	161	189	205	242
1991	161	182	240	271
1992	192	207	217	235
1993	155	168	218	236
1994	178	189	233	247
1995	230	239	279	289
1996	217	217	268	268
Average	200	256	255	324
Standard Deviation	51	93	60	104

Appendix 2

Guam

CONTENTS

1. Introduction 2.2

2. Summary 2.3

3. Historical Annual Statistics 2.4

4. Recommendations 2.5

5. List of Tables 2.7

6. List of Figures 2.7

Introduction

Guam has two distinct bottomfish fisheries which can be separated by depth and species. The shallowwater complex (100-500 feet) of bottomfish management unit species (BMUS) makes up a larger portion of the total bottomfish harvest and is comprised of an assemblage of reef-dwelling snappers, groupers and jacks of the genera *Lutjanus, Lethrinus, Aprion, Epinephelus, Variola, Cephalopholis* and *Caranx*. The deepwater BMUS complex (500-700 feet) consists primarily of snappers and groupers of the genera *Pristipomoides, Etelis, Aphareus, Epinephelus,* and *Cephalopholis*.

Bottomfishing on Guam is a combination small-scale commercial and subsistence fishery. This fishery is also highly seasonal in that most bottomfishing effort occurs during the summer months when sea conditions are generally much calmer. The majority of the participants are part-time recreational and subsistence fishermen who operate vessels less than 25 feet in length, primarily target the shallowwater bottomfish complex, combine some trolling effort to supplement bottomfishing effort, and seldom sell their catch commercially.

Historically, notable fluctuations in Guam's annual BMUS harvests have been caused by the respective entry and exit of highliner vessels. These highliner vessels tend to be greater than 25 feet in length and their effort is usually concentrated on the deepwater bottomfish complex.

Adding to Guam's total bottomfishing effort in recent years is the charter fishing component which now includes boats making multiple two to four-hour bottomfishing trips daily. The types of vessels making such trips range from the more typical trolling charter boat involving 3-6 patrons who opt to bottomfish instead, to the larger bottomfishing-only "party-boat" vessels accommodating as many as 30 patrons per trip.

Centrally located on the western leeward coast, the Agana Boat Basin serves as the Island's primary small-boat launch site to fishing areas off the central and northern leeward coast as well as the northern banks. Situated to the south, the Merizo Pier, Umatac Boat Ramp and Agat Marina serve as access points to the southern shores and banks. The Agat Marina in particular, located between the Agana Boat Basin and the Merizo Pier, provides boats trailered from the northern and central portions of the island a closer and more convenient launch site to the southern fishing grounds. Plans to construct three additional boat ramps at presently undeveloped eastern windward launch sites are currently being considered. If completed, the new boat launches are expected to lead to a significant increase in bottomfishing effort on the eastern side of the island.

The demand for both deep and shallowwater bottomfish continues to exceed the locally-caught supply. Although Guam's deepwater bottomfish fishery has limited economic importance, especially during the absence of highliner vessels, the cultural value of its shallowwater complex remains high due to the popularity of this assemblage of fish as food items. Some of the demand for both complexes of bottomfish is offset with imports from other

islands throughout Micronesia. The quality, competitive pricing and consistent availability of imported fish continues to have the effect of discouraging local attempts to supplant foreign catches with Guam-caught fish.

Summary

Guam's offshore survey data continues to be expanded utilizing a spreadsheet format that does not include complemental statistics of confidence or biological data such as mean species lengths. However, the implementation of an offshore creel survey at the Merizo Pier in 1991 and the Agat Marina in 1994, as well as recent revisions of algorithms to expand the offshore survey data, has increased the confidence in the expansion results using this spreadsheet format. Species composition is still limited to BMUS and a few other species of major importance.

DAWR is presently working with the WPacFIN program coordinator to develop a state-of-the-art database computer program that will provide DAWR with the capability of integrating the offshore survey expansion data with the inshore survey expansion data, and additionally produce statistics of confidence, a compilation of biological data, and a complete species composition analysis. DAWR further intends to purchase additional computer software and hardware that will facilitate production of annual reports utilizing standardized wordprocessing, spreadsheet and graphics software.

Analysis of the expanded 1996 bottomfish fishery data indicates that Guam's aggregate CPUE per boat trip for all bottomfishing methods, including deep and shallowwater complexes in both territorial and federal waters, has improved from last year's 3.2 pounds-per-hour to 4.6 pounds per hour. This improvement in CPUE has resulted in the cancellation of the "yellow light" condition based on the CPUE indicator of fishery stress that was reported in the 1995 annual report. Given the above, it is therefore recommended that no management action be taken for Guam's BMUS stocks in federal waters.

An annual summary of total bottomfish landings, CPUE, inflation-adjusted revenues, bottomfish price per pound and number of boats participating in the fishery since 1980 are provided on the following page.

Historical Annual Statistics

Year	Total Bottomfish landing	CPUE (lbs/trip hr)	Inflation-adjusted revenues ($)	Inflation-adjusted price/lb ($)	Number of boats
80	37399	5.9	39520	4.21	24
81	63654	7.6	53242	5.09	75
82	63442	7.2	34739	5.25	49
83	53404	5.1	172508	4.75	48
84	56998	7.7	97267	4.84	79
85	94318	7.4	120691	4.46	63
86	30368	5.8	48304	4.21	39
87	35033	5.6	51177	4.05	96
88	52791	5.0	61058	3.87	107
89	53272	5.2	87567	4.50	110
90	45374	5.6	79842	4.34	116
91	51329	5.4	44715	4.15	173
92	50099	5.5	39498	3.82	173
93	78355	4.8	36362	3.56	271
94	83367	6.7	109335	3.62	268
95	108741	3.2	44236	3.312	422
96	**137790**	**4.6**	**17492**	**2.66**	**400**
Ave.	64455	5.8	66915	4.16	148
SD	28201	1.2	39601	0.66	123

Recommendations

Status of 1995 recommendations:

Action taken on recommendation 1a to develop a customized computer software program to update, standardize and reprocess Guam's survey data resulted in DAWR working directly with the WPacFIN program coordinator to achieve this goal rather than hiring a private contractor. Efforts to achieve the above goals are presently ongoing. Action on recommendations 1b and c are pending completion of 1a.

No action was taken on recommendation 2 to complete a baseline biological survey of the red-gilled emperor (*Lethrinus rubrioperculatus*), and 3 to calculate mean fish size, percent immature and SPR for both the deep and shallowwater complexes, because it is still not clear where and how DAWR will acquire the assistance necessary for such research projects.

1996 Recommendations:

1) Recognizing that results derived from the spreadsheet format presently being used for Guam's BPT annual reports are not completely representative of the data analysis required by the Council, and that this deficiency continues to jeopardize confidence in the data presented in the Guam reports, every effort should be made to complete the state-of-the-art database computer program that will provide DAWR with the capability of integrating the offshore survey expansion data with the inshore survey expansion data, and additionally produce statistics of confidence, a compilation of biological data, and a complete species composition analysis. Specifically, to:

a. Continue working directly with the WPacFIN program coordinator to complete a customized computer program that will update, standardize and reprocess the DAWR creel survey database as well as meet the Plan Team's annual reporting requirements;
b. provide necessary manpower for the immediate implementation, input and processing of the DAWR creel survey database from 1980 to present;
c. train designated DAWR staff to use the new software and to interface with NMFS/WPacFIN software to facilitate additional support in the processing and analysis of fisheries data if necessary.

2) The need to complete a baseline biological survey of the red-gilled emperor (*Lethrinus rubrioperculatus*) remains as the single most important data deficiency for the Marianas shallowwater bottomfish resource. Thus, the previous recommendations in the '92 through '96 Guam annual reports to establish a joint program with the CNMI continues to be a priority; especially in light of the fact that the window of opportunity to conduct such a project with the CNMI's virgin stocks is rapidly closing as commercial bottomfishing operations continue to

grow in number and increase their fishing effort.

3) With the assistance of the National Marine Fisheries Service, calculate the mean fish size, percent immature and spawning potential ratio (SPR) indicators for Guam's deep *and* shallowwater bottomfish complexes.

Tables

page

1. Guam 1996 expanded creel survey composition of allocated bottomfish management unit species (BMUS) 8
2. Guam 1996 commercial bottomfish average price 11

Figures

page

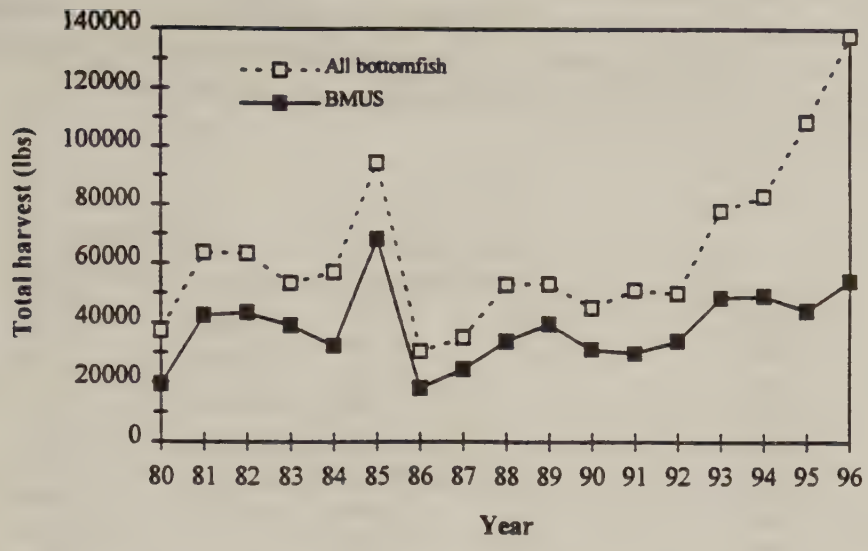
1. Guam harvest of BMUS and all bottomfish 9
2. Total and commercial BMUS harvest, and revenue 12
3. Estimated boat hours and trips 14
4. Guam bottomfish fishery participation 16
5. Average bottomfish prices 18
6. Guam bottomfish CPUE 20
7. Guam average revenue per trip 22

Table 1. Guam 1996 expanded creel survey composition of bottomfish management unit species (BMUS)

Species	Bottomfishing method only (lbs)
Lehi (*A. rutilans*)	1,810
Uku (*A. virescens*)	5,660
Jacks (*C. ignobilis, C. lugubris*)	3,355
Groupers (*C. urodeta, E. fasciatus, V. louti*)	9,182
Ehu (*E. carbunculus*)	2,271
Onaga (*E. coruscans*)	1,577
Emperors (*L. amboinensis, L. rubrioperculatus*)	10,720
Taape (*L. kasmira*)	1,745
Kalekale (*P. seiboldi*)	0
Yellowtail Kalekale (*P. auricilla*)	10,435
Pink Opakapaka (*P. filamentosus*)	1,891
Yelloweye Opakapaka (*P. flavipinnis*)	1,829
Gindai (*P. zonatus, P. argyrogrammicus**)	3,427
Amberjack (*S. dumerilii*)	220
Total	**54,122**

*non-BMUS species

Figure 1. Guam Harvest of BMUS and all bottomfish



Interpretations: Annual fluctuations in bottomfish landings on Guam are usually due to the number of boats, particularly highliners, entering or leaving the fishery during a given year. The 1985 peak, and apparent crash in 1986, of total bottomfish and BMUS harvests were largely the result of a few highliner fishermen who fished in 1985 and then left the fishery in 1986. Likewise, the 64% average increase in '93-'94 over the preceding years in '91-'92 is mirrored by a similar 64% average increase in the number of boats (see Figure 4) bottomfishing in '93-'94, which also included the reentry of several highliner fishermen. The 23% increase in1995 of total bottomfish harvest is best explained by the 58% increase in the number of recreational and subsistence-type boats participating in the fishery that year. Conversely, the 17% reduction in BMUS landings in 1995 are attributed to the absence or reduced effort of several highliners in the fishery. To be sure, an analysis was conducted of the total annual commercial landings of six highliners who combined, have landed an average of 18% of the total BMUS harvest for the last four years and 68% of the unexpanded total commercial landings for the same period. The results indicated a 45% reduction in their total bottomfish harvest dropping from 13,349 pounds in 1994, down to 6,023 pounds in 1995. The 45% drop in highliner landings accounts for about a half of the 1995 decline in total BMUS landings. The slight increase in 1996 of the total BMUS harvest was the result of increased effort on the part of the recreational and subsistence components of the fishery since highliner participation in 1996 was almost nonexistent. The more dramatic rise in the past year's "all bottomfish" category is believed to be the result of expanded survey data from bottomfish interviews that included exceptional catches of the bigeye scad, *Selar crumenopthalmus*.

Source: The DAWR offshore creel survey data as expanded by computer-based algorithms by method of fishing. All unidentified catch was allocated to species categories based on the species percentage of the total catch.

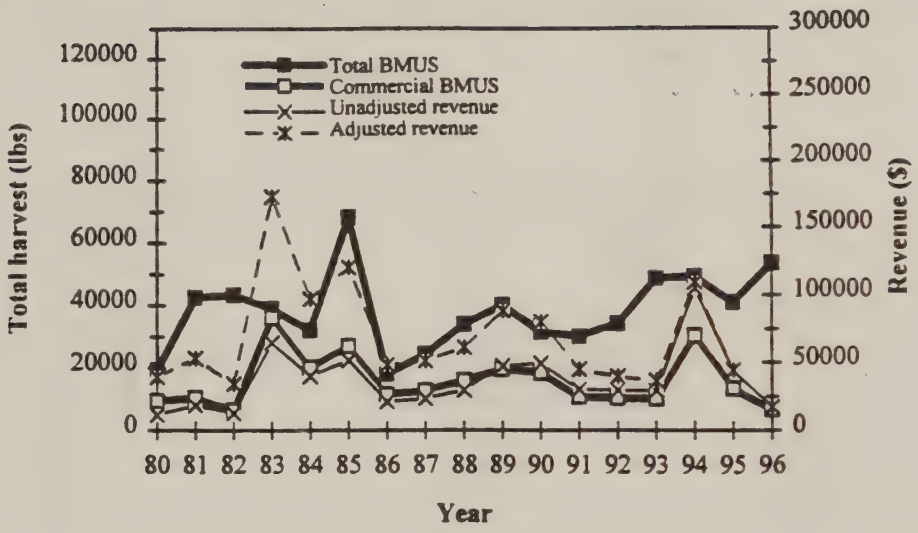
Calculations: The estimated total landings of the bottomfish species are selected from the expanded creel survey species composition files. However, the expanded estimates of catch by species must include at least a portion of the catch identified only by generic species codes categories. These generic categories (e.g. "mixed shallow bottomfish") also include some non-BMUS bottomfish according to the FMP definition (e.g. squirrelfish).

Year	Total Bottomfish Harvest (lbs)	Total BMUS Harvest (lbs)
1980	37,399	19,253
1981	63,654	42,517
1982	63,442	43,428
1983	53,404	39,193
1984	56,998	32,232
1985	94,318	68,141
1986	30,368	17,969
1987	35,033	24,288
1988	52,791	33,724
1989	53,272	39,814
1990	45,374	31,295
1991	51,329	29,962
1992	50,099	34,057
1993	78,355	48,494
1994	83,367	49,169
1995	108,741	44,135
1996	137,790	54,122
Average	64,455	38,341
Standard deviation	28,201	12,774

Table 2. Guam 1996 commercial bottomfish average price

Species	Average $/lb
Miscellaneous Bottomfish	2.78
Grouper	2.57
Jacks	1.90
Lehi	3.74
Uku	2.15
Ehu	4.00
Onaga	5.64
Opakapaka	4.00
Kalekale	3.26
Gindai	4.00
Emperor	2.66
Amberjack	2.45
All Bottomfish Species	**2.66**

Figure 2. Total and commercial BMUS harvest, and revenue



Interpretations: The nearly 300% increase in 1994 of the total commercial BMUS harvest and revenue is the result of additional highliner vessels entering (or reentering) into the fishery during that year. The 39% reduction in total BMUS landings and 56% decline in total commercial harvest for 1995 are best explained by the absence or reduced effort of about six highliners who combined, have landed an average of 18% of the total BMUS harvest for the last four years and 68% of the unexpanded total commercial landings for the same period. Harvest records for these six highliners indicate a 45% reduction in 1995 of their total bottomfish harvest dropping from 13,349 pounds in 1994, down to 6,023 pounds in 1995. This decline in 1995 of highliner landings accounts for about two-thirds of the 1995 reduction in total commercial BMUS harvest. In 1996 commercial BMUS harvest and adjusted revenue dropped to its lowest point ever, owing in large part to the almost complete absence of highliner activity in the fishery.

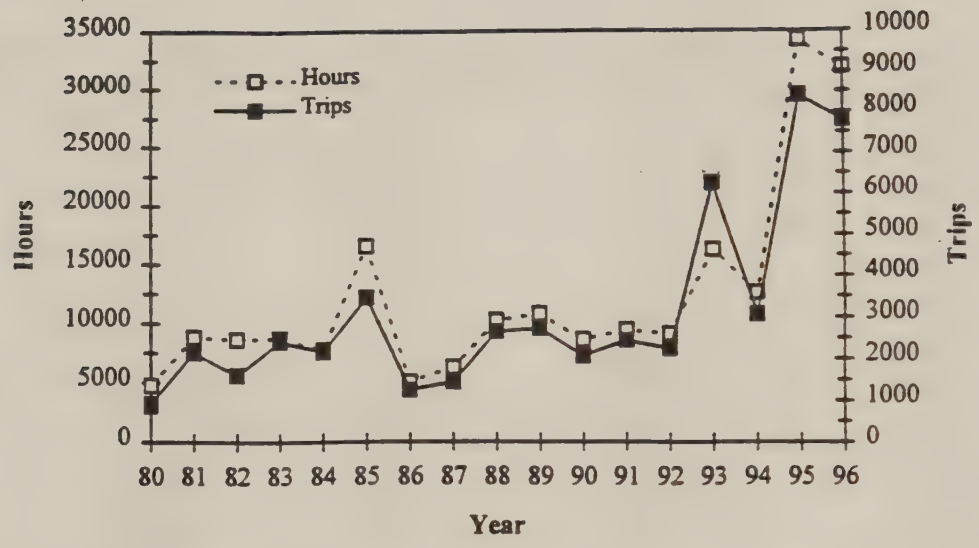
Source: The estimated total landings are from the DAWR creel survey system, and the commercial data are from the WPacFIN-originated commercial landings system.

Calculations: The total commercial bottomfish landings and revenue for each year were calculated by summing the weight and value fields in the commercial landings data base and then multiplying by an estimated percent coverage expansion factor. This annual expansion factor was subjectively created and includes an analysis of the "disposition of catch" data available from the DAWR offshore creel survey, an evaluation of the fishermen in the fishery and their entry and exit patterns, general dock-side knowledge of the fishery, status of marketing conditions and its structure, overall number of records in the data base,

and a measure of the best-educated guess.

Year	Total BMUS Harvest (lbs)	Commercial BMUS Harvest (lbs)	Unadjusted Revenue ($)	Inflation-Adjusted Revenue ($)
1980	19,253	9,381	11,458	39,520
1981	42,517	10,459	18,590	53,242
1982	43,428	6,617	12,753	34,739
1983	39,193	36,281	65,543	172,508
1984	32,232	20,115	40,176	97,267
1985	68,141	27,064	51,777	120,691
1986	17,969	11,482	21,289	48,304
1987	24,288	12,639	23,551	51,177
1988	33,724	15,792	29,568	61,058
1989	39,814	19,442	47,029	87,567
1990	31,295	18,390	48,983	79,842
1991	29,962	10,773	30,234	44,715
1992	34,057	10,344	29,410	39,498
1993	48,494	10,125	29,348	36,362
1994	49,169	30,237	104,827	109,335
1995	40,924	13,339	43,929	44,236
1996	53,573	6,578	17,492	17,492
Average	38,120	15,827	36,821	66,915
Standard deviation	12,664	8,494	23,103	39,601

Figure 3. Estimated boat hours and trips



Interpretations: The almost three-fold increase in 1995 of both total boat hours and boat trips are attributed to the nearly 60% increase in the number of boats, primarily recreational and subsistence, entering into the fishery during the year, and calm seas throughout most of 1995 which enabled many of them to bottomfish more often than usual. In 1994 there was a 49% reduction in the total number of boat trips and a concomitant 23% drop in the total number of boat hours from the previous year's totals despite increases of approximately 1% in the total BMUS harvest and a dramatic 300% in commercial BMUS catch for the same year (see Figure 2). Contributing to the apparent '94 declines was the extended period of unusually calm seas in late '93 which resulted in an exceptionally high number of boats bottomfishing that year. Thus, the '94 "declines" are somewhat misleading as they could also be considered as more representative of a steady and increasing trend in the total number of boat trips and boat hours since 1986. The succession of typhoons and inclement weather that hit Guam between '90 and '92 may have suppressed the expected continued trend of a steady and slight increase in the number of boat trips and boat hours from '86 to '94. The 1995 peak is likely the result of expanded survey data collected from charter bottomfishing vessels operating out of the Agat Marina (offshore creel surveys at the Agat Marina began in 1994 and almost always include several bottomfishing vessels making multiple trips on each survey day). The charter boat component of the bottomfish fishery in 1996 accounted for 23% of the total number of bottomfishing trips, and 13% of the hours fished The 1996 drop in boat hours and trips may have been the result of the almost complete absence of highliners participating in the fishery this past year.

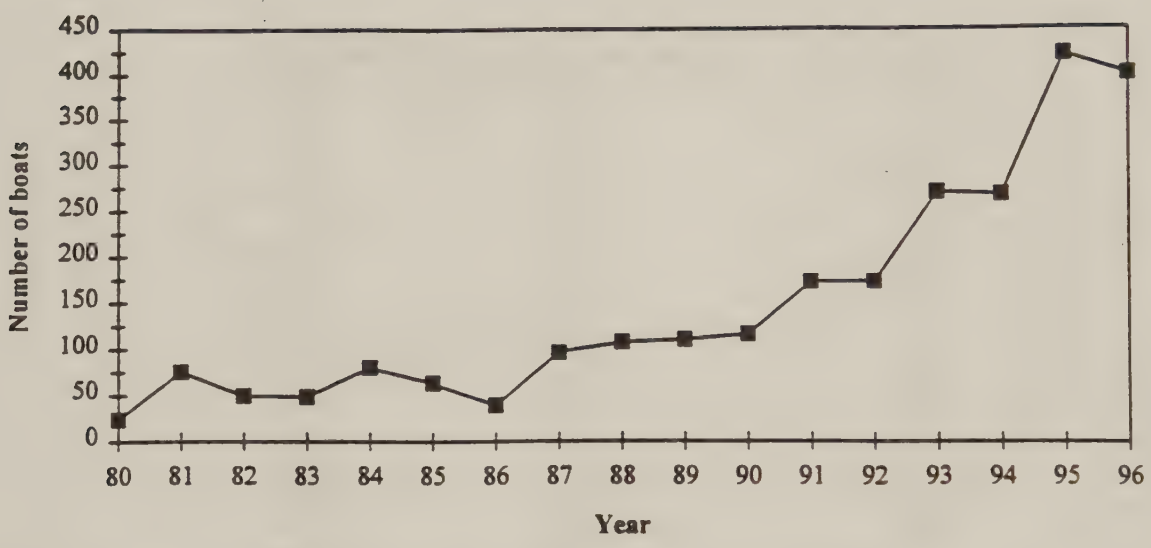
Source: The DAWR creel survey data for bottomfishing methods.

Calculations: The estimated number of boat trips and boat hours for bottomfishing

methods are derived directly from the creel survey expansion algorithms.

Year	Total Boat Hours	Total Boat Trips
1980	4,752	929
1981	8,804	2,150
1982	8,621	1,606
1983	8,699	2,401
1984	7,730	2,160
1985	16,477	3,471
1986	5,018	1,246
1987	6,264	1,447
1988	10,208	2,653
1989	10,818	2,732
1990	8,628	2,060
1991	9,440	2,444
1992	9,072	2,234
1993	16,238	6,265
1994	12,512	3,056
1995	34,233	8,399
1996	31,874	7,790
Average	12,317	3,120
Standard deviation	8,448	2,211

Figure 4. Guam bottomfish fishery participation



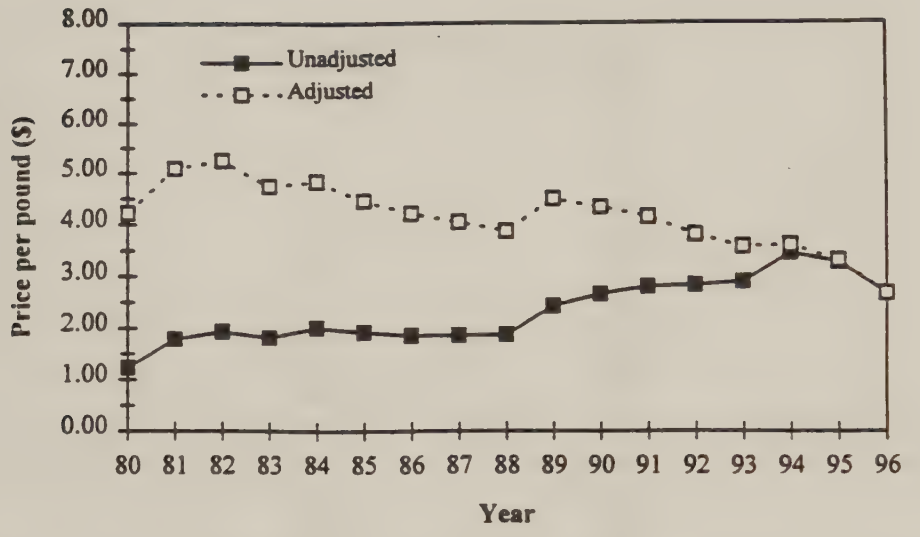
Interpretations: Over the last several years the number of boats participating in this fishery has increased steadily and continues to grow. The approximately 57% increase between 1992 and 1994 is believed to be the result of an increase in the sampling effort with the inclusion of the Merizo Pier as a survey site in 1991, a healthy economy that has made it possible for more residents to afford boats, and a return of fair weather that allowed for more favorable fishing conditions. Another 57% increase occurred in 1995 due in part to an increase in sampling effort and island-wide coverage with the inclusion of the Agat Marina as an offshore creel survey site in October, 1994. Most of the newcomers however, are believed to be recreational and subsistence-type vessels who bottomfish only part-time and primarily target the shallowwater bottomfish complex.

Source: DAWR offshore creel survey boat log data from Agana Boat Basin, Agat Marina and Merizo Pier boat launch sites. The data was converted and processed using the WPacFIN-generated boat estimator model.

Calculations: The 1996 figure was obtained by first running the above-mentioned model 1,000 times using a randomly selected order of the days sampled at all three ports combined, then eliminating the upper and lower 25 estimates to rid the model of ocassional outlier estimates; and finally calculating the mean and standard deviation for the remaining 950 estimates. The removal the outliers conducted in the second step lowered the original estimated number of boats after the model was run 1,000 times by about 1%, but more importantly, reduced the standard deviation by approximately 20%. Previous year's estimates were calculated using a similar conservative threshold C/E model which was run a minimum of 15 times per year.

Year	Number of Boats
1980	24
1981	75
1982	49
1983	48
1984	79
1985	63
1986	39
1987	96
1988	107
1989	110
1990	116
1991	173
1992	173
1993	271
1994	268
1995	422
1996	400
Average	148
Standard deviation	123

Figure 5. Average bottomfish prices



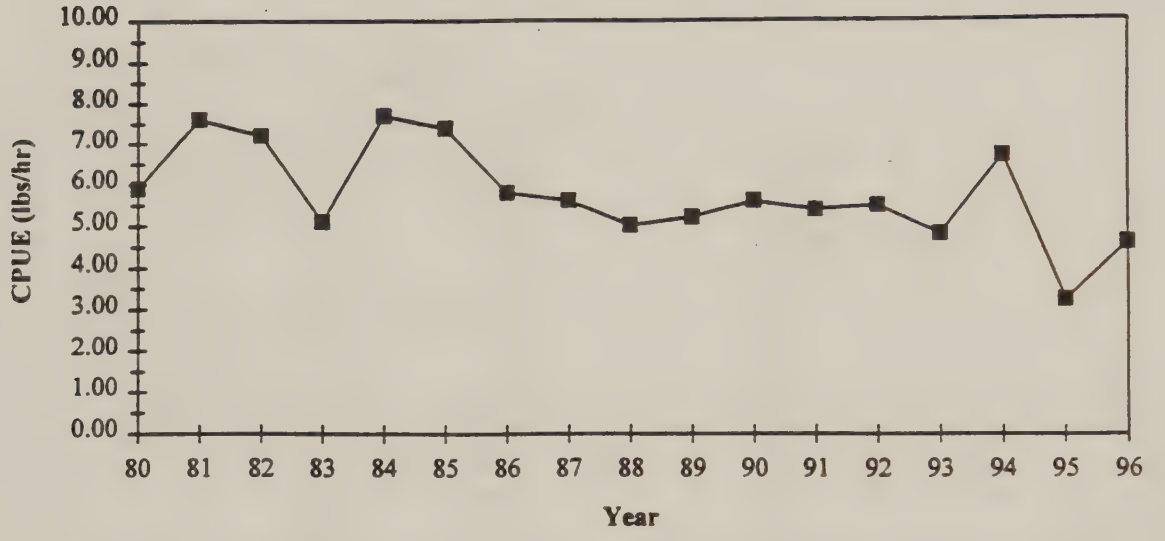
Interpretations: The adjusted average price for bottomfish has not shown consistent marketing trends. This is believed to be the result a seasonal availability of pelagic fish and difficulties in developing a consistent market for locally-caught fish. In addition, imported fish from other islands around the region has contributed to the continued marketing problem for local fishermen. The 1996 inflation-adjusted average bottomfish price of $2.66 is the lowest ever recorded and may explain why local highliners were almost completely absent from the bottomfish fishery in the past year.

Source: The commercial landings data from the major wholesalers.

Calculations: The average price of all bottomfish species combined is calculated by dividing the total bottomfish revenue by the sold weight. The inflation adjustment is made by using the Consumer Price Index (CPI) for Guam and establishing the 1996 figure as the base from which to calculate expansion factors for all previous years (e.g. divide the 1996 CPI by the CPI for any given year), and then multiplying the unadjusted average price by this factor to obtain the adjusted average price for the given year.

Year	Unadjusted $/lb	Adjusted $/lb
1980	1.22	4.21
1981	1.78	5.09
1982	1.93	5.25
1983	1.81	4.75
1984	2.00	4.84
1985	1.91	4.46
1986	1.85	4.21
1987	1.86	4.05
1988	1.87	3.87
1989	2.42	4.50
1990	2.66	4.34
1991	2.81	4.15
1992	2.84	3.82
1993	2.90	3.59
1994	3.47	3.62
1995	3.29	3.32
1996	2.66	2.66
Average	2.31	4.16
Standard deviation	0.62	0.66

Figure 6. Guam Bottomfish CPUE



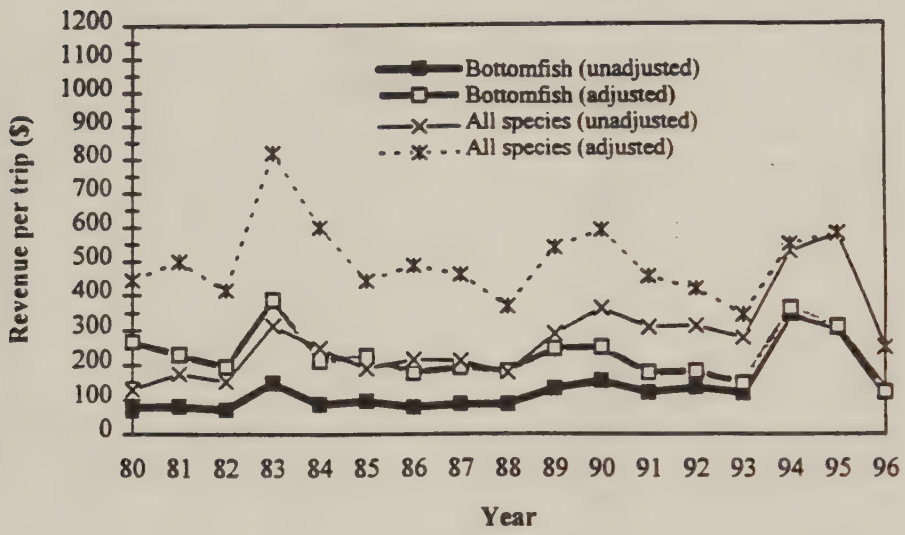
Interpretations: Historically, the annual CPUE has fluctuated around 5 to 8 pounds per hour and has up until the last three years remained fairly stable. In 1995 the CPUE fell to an all-time low of 3.2 pounds per hour, owing in large part to an increasing number of recreational and subsistence-type vessels continuing to enter into the fishery; most of which target the less-productive shallowwater complex of bottomfish. Based on an aggregate catch-per-unit effort average of 6.9 pounds per hour for the first three years of data collection on Guam, the 1995 figure placed the fishery in a "yellow light" condition. In 1996 however, the CPUE improved to 4.6 pounds per hour, thereby cancelling this indicator of fishery stress.

Source: The DAWR creel survey data for the bottom fishing method.

Calculations: The yearly catch-per-unit-effort (CPUE) is calculated by using the year-end survey totals and dividing the total weight of bottomfish landed by the total number of hours spent bottomfishing.

Year	CPUE (lbs/hr)
1980	5.9
1981	7.6
1982	7.3
1983	5.1
1984	7.7
1985	7.5
1986	5.8
1987	5.6
1988	5.0
1989	5.3
1990	5.6
1991	5.4
1992	5.5
1993	4.8
1994	6.7
1995	3.2
1996	4.6
Average	5.8
Standard deviation	1.2

Figure 7. Guam average revenue per trip



Interpretations: The inflation-adjusted average revenue per trip for both the "bottomfish" and "all species" categories fell dramatically in 1996 and was likely due to fewer highliners participating in the fishery. Furthermore, some of the more experienced fishermen who use to sell their catch to vendors participating in the DAWR commercial receipt book program, may have chosen instead to market their catch on their own, or sold their catch to vendors who were not part of the commercial receipt book program. The increase in the amount of imported bottomfish from around Micronesia (Palau, Chuuk, Pohnpei, etc.) that began sometime around 1991 with the addition of frequent airline routes to Guam, may explain the slight decrease in revenues between 1991 and 1993. The substantial increases in the inflation-adjusted average revenue per trip in 1994 are best explained by the success of the highliner vessels during that year. The 1995 increase in revenue for the "all species" category and the decrease in revenue for the "bottomfish" category, indicates that most commercial fishermen on average continue to make more money from their trolling efforts than from bottomfishing.

Source: The commercial landings data from major wholesalers.

Calculations: The average revenue per trip for all species is calculated by summing the revenue of all species sold for any trip which landed bottomfish species, and dividing by the number of trips. The average bottomfish revenue per trips is calculated from those same trips by summing the sales of only bottomfish species and dividing by the number of trips.

Year	$/Trip (Bottomfish) Unadjusted	$/Trip (Bottomfish) Adjusted	$/Trip (All Species) Unadjusted	$/Trip (All Species) Adjusted
1980	77	267	129	445
1981	80	228	174	500
1982	71	194	152	415
1983	147	386	312	821
1984	87	211	248	601
1985	96	225	190	442
1986	78	177	215	487
1987	88	192	212	461
1988	87	181	178	368
1989	132	246	290	540
1990	154	251	363	592
1991	120	177	308	456
1992	134	181	311	418
1993	118	146	277	343
1994	346	360	528	551
1995	306	309	578	582
1996	121	121	250	250
Average	132	227	277	487
Standard deviation	78	72	122	127

Appendix 3

Hawaii

Contents

page

1. Introduction 3.2
2. Summary 3-2
3. Recommendations 3-3
4. List of Tables 3-4
5. List of Figures 3-4
6. Historical Annual Statistics for Main Hawaiian Islands and Mau Zone 3-5
7. Historical Annual Statistics for Hoomalu Zone 3-6

Introduction

The commercial bottomfish stocks in the Hawaiian Islands are divided into two fisheries: seamount groundfish and deep-slope bottomfish. The seamount fishery targets alfonsin, Beryx spp., and armorhead, Pseudopentaceros wheeleri. The only area in the US EEZ for this fishery is Southeast Hancock Seamount located 1,400 nm northwest of Honolulu. This trawl fishery was started by the Russians and Japanese in the late 1960s and large catches were made for about 10 years until they caused a crash in the fishery. This fishery has never been domestically harvested. A moratorium on fishing within the US EEZ began in 1986 and continues through the present as no substantial recovery in the fishery has been observed.

The deep-slope bottomfish fishery in Hawaii concentrates on species of eteline snappers, carangids, and a single species of grouper concentrated at depths of 30-150 fathoms. These fish have been fished on a subsistence basis since ancient times and commercially for at least 90 years. The deep-slope fishing grounds within the US EEZ are divided into three management zones. The inhabited main Hawaiian Islands (MHI) support numerous subsistence, recreational, and commercial fishermen with considerable overlap by category. The uninhabited Northwestern Hawaiian Islands (NWHI) are divided into the Mau Zone, closer to the MHI, and the Hoomalu Zone. Fishing in these zones is conducted solely by commercial fishermen and requires federal licensing for such activities. The Hoomalu Zone is a limited entry zone with 6 vessels participating in 1995; 10 vessels fished the Mau Zone in the same year.

Vessel size varies considerably with larger fully commercial vessels (30 ft in length and over) conducting trips of about 10 days, and smaller vessels (<30 ft) generally restricted to the MHI and trips of 1-3 days. Most vessels in this fishery are fully outfitted with electronic navigation and fish-finding equipment, as well as with electric or hydraulic line-hauling equipment. The catch is sold fresh in the round for local consumption.

Catch and revenue data for bottomfish have been collected by the State of Hawaii Division of Aquatic Resources (HDAR) since 1948 in the form of a report submitted by commercial fishermen. No data is collected for recreational or subsistence fishermen, but their catch is estimated to be about equal to the commercial catch in the MHI. Data obtained from a market monitoring program and data from fishermen interviews are combined with the HDAR data set for the analysis presented in this report.

Summary

The MHI bottomfish fishery has remained relatively stable over the last few years. Landings decreased slightly in 1996 as compared to 1995 as did effort resulting in the lowest CPUE on record for the MHI. Stocks of many of the BMUS species in this zone are stressed. Each of the BMUS species evaluated have a yellow light condition due to a drop in CPUE below 50% of original values. In addition, Onaga and ehu stocks are recruitment overfished by definition since the SPR values are at or below 20% for these species (5% and 8% for onaga and ehu,

respectively, using the targeted CPUE). These SPR levels are red light conditions demanding immediate action.

Bottomfish stocks in the NWHI appear to remain relatively healthy. CPUE is 49% of the original level in the Mau Zone (a yellow light condition) and 66% in the Hoomalu zone. Analysis of SPR and percent immature in the catch show no problems to date for either zone.

Armorhead stocks outside of the US EEZ experienced a short pulse in recruitment in 1992 which did not carry over into 1993. SPR values at Southeast Hancock Seamount are the highest since 1986, but at 2.5% in 1993 they still indicate a collapsed fishery. Data for Hancock Seamount has not been available since 1994, but is available for areas outside of the US EEZ for years through 1995 (1996 values are not yet available).

Recommendations

1. The BPT reiterates its concerned regarding the continuing overfished condition of the MHI onaga and ehu stocks as it adds hapuupuu to the list. The Team recommends continued support for the ongoing efforts of the DLNR bottomfish task force toward establishing effective management regulations for the MHI fishery.

2. Again, the BPT strongly encourages the State to proceed expeditiously with computerization of the fish and seafood dealer reporting system and integrate this with the fishermen's commercial catch reporting system.

3. The BPT encourages NMFS and the State to increase the level of bottomfish catch monitoring of the Honolulu auction and expand this sampling to major dealers on all other main Hawaiian Islands.

Tables

page

1. Historical Annual Statistics Main Hawaiian Islands 3-5
2. Historical Annual Statistics Mau Zone 3-5
3. Historical Annual Statistics Hoomalu Zone 3-6
4. Hawaii Bottomfish Market Ex-vessel Prices by Species 3-34
5. NWHI Ho'omalu zone bottomfish vessel income statement 3-35
6. NWHI Ho'omalu zone bottomfish vessel economics 3-37
7. NWHI Mau zone bottomfish vessel income statement 3-38
8. NWHI Mau zone bottomfish vessel economics 3-39
9. "Optimal" number of NWHI bottomfish vessels 3-40

Figures

1. Hawaii's bottomfish landings from the NWHI and MHI 3-7
2. NWHI BMUS species composition per trip by weight 3-10
3. NWHI BMUS species compostion by weight 3-13
4. Number of trips made by NWHI bottomfish fleet 3-15
5. Number of vessels in the NWHI bottomfish fleet 3-17
6. MHI species composition of landings by weight 3-19
7. Standard MHI bottomfishing trips and vessels 3-21
8. Current year and historical catch compostion 3-23
9. Hawaii domestic bottomfish landings and revenue 3-24
10. Hawaii bottomfish market
(annual *inflation-adjusted ex-vessel prices and domestic landings) 3-26
11. Hawaii bottomfish landings and revenue by source 3-27
12. Hawaii bottomfish ex-vessel prices by source 3-29
13. Hawaii bottomfish ex-vessel prices by zone 3-31
14. NWHI bottomfish inflation-adjusted revenue per trip by zone 3-34
15a. CPUE for Hawaiian bottomfish 3-42
15b. Partial CPUE for MHI bottomfish 3-45
15c. Partial targeted CPUE for MHI bottomfish 3-48
16. Percent immature in Hawaiian bottomfish catch 3-51
17. Mean weight of Hawaiian bottomfish 3-53
18a. Spawning potential ratio (SPR) for MHI bottomfish using aggregate CPUE 3-55
18b. Spawning potential ratio (SPR) for MHI bottomfish using targeted CPUE 3-57
19. Spawning potential ratio (SPR) for NWHI bottomfish 3-59
20. Research CPUE on SE Hancock Seamount 3-61
21. Armorhead SPR 3-64
22. Armorhead CPUE 3-64

Table 1. Historical Annual Statistics: Main Hawaiian Islands

Year	Total Landings (lbs)	CPUE (lbs/trip)	Inflation Adjusted Revenue	Price per Pound	Number of Vessels	SPR Average
1986	810,111	274	$3,175,000	NA	985	33
1987	785,000	237	$3,454,000	$4.40	797	25
1988	1,166,000	329	$4,571,000	$3.91	785	37
1989	1,007,000	361	$4,141,000	$4.11	739	40
1990	651,000	245	$2,811,000	$4.31	992	27
1991	562,000	202	$1,981,000	$3.52	601	24
1992	588,000	228	$2,034,000	$3.46	742	25
1993	462,000	213	$1,644,000	$3.55	532	24
1994	536,000	218	$1,873,000	$3.44	747	24
1995	568,000	193	$1,848,000	$3.26	784	22
1996	421,000	176	$1,540,000	$3.66	1079	21
Average	686,919	243	$2,642,909	$3.76	798	27
Standard Deviation	232,737	57	$1,057,299	$0.40	165	6

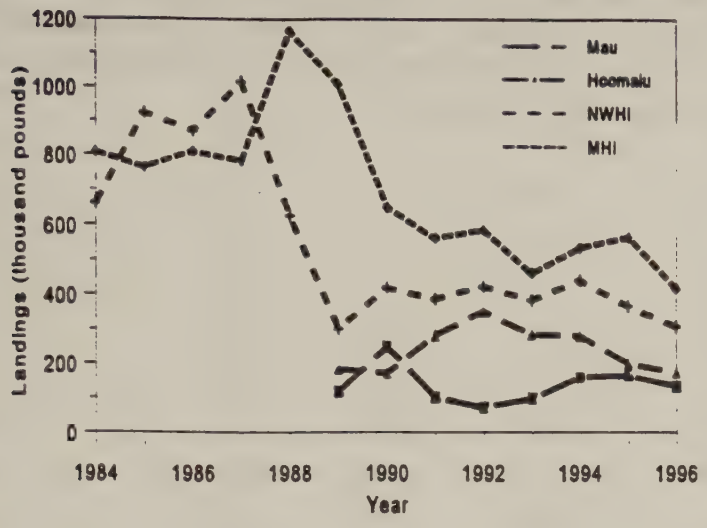
Table 2. Historical Annual Statistics: Mau Zone

Year	Total	CPU	Inflation	Price	Number	SPR
1986	NA	2,206	NA	NA	NA	41
1987	NA	2,889	NA	NA	NA	50
1988	NA	2,136	NA	NA	4	37
1989	118,000	5,412	$418,000	$3.53	5	91
1990	249,000	4,454	$791,000	$3.17	14	77
1991	103,000	2,413	$348,000	$3.37	14	42
1992	71,000	2,092	$232,000	$3.26	8	38
1993	98,000	1,992	$287,000	$2.92	8	36
1994	160,000	3,748	$501,000	$3.12	12	68
1995	166,000	2,460	$474,000	$2.86	10	45
1996	135,000	2,876	$417,000	$3.09	12	54
Average	137,500	2,971	$433,500	$3.17	10	53
Standard Deviation s.d.	55,175	1,112	$170,667	$0.22	4	18

Table 3. Historical Annual Statistics: Hoomalu Zone

Year	Total	CPUE	Inflation	Price	Number	SPR
1986	NA	5,301	NA	NA	NA	75
1987	NA	8,187	NA	NA	NA	113
1988	NA	4,702	NA	NA	12	66
1989	184,000	5,328	$594,000	$3.22	5	70
1990	173,000	4,793	$545,000	$3.14	5	64
1991	283,000	5,928	$854,000	$3.02	4	82
1992	353,000	7,388	$1,138,000	$3.22	5	98
1993	287,000	8,040	$920,000	$3.20	4	109
1994	283,000	4,651	$929,000	$3.28	5	64
1995	202,000	5,544	$606,000	$3.00	5	73
1996	176,000	5,588	$576,000	$3.27	3	75
Average	242,625	5,950	$770,250	$3.17	5	81
Standard Deviation	67,386	1,309	$219,217	$0.11	3	18

Figure 1. Hawaii's bottomfish landings from the NWHI and MHI



Interpretation: Data for 1995 has been updated and now shows a decline in NWHI landings from those of 1994. The 1996 data shows a continuing decrease of landings. Mau zone landings have decreased more substantially than those from the Hoomalu zone..

Mau zone landings had continued to rise steadily since Hurricane Iniki in 1992 until 1996. On a per trip basis the landings also show a slight decline in 1996. Up until 1996 the landings had rebounded yearly as the Kauai fleet re-entered the fishery and a new full-time vessel from Maui entered the fleet in 1994. Landings of pelagic species have increased over 1995 to nearly 90,000 lobs in 1996. Pelagic species landings are an important part of the landings for the Mau zone, especially for the vessels that make short combination pelagic and bottomfish trips in which the targeted species are pelagic.

Hoomalu zone landings have continued to decline since 1992 due to a decline in fishing effort in terms of number of trips and vessels throughout the subsequent years. The landings of BMUS per trip had declined between 1992-1994 but has been relatively stable for the last 2 years. Landings were down for the major target species--onaga and opakapaka. Ehu, butaguchi, and uku landings made up for the shortfall on the target species.

Source: Data are primarily from HDAR and supplemented with data from NMFS market monitoring program. Data are only those from BMUS and other bottomfish species. Pelagic species were not included.. Data for 1996 are preliminary.

Calculation & Adjustment: The HDAR integrated data set was supplemented with very limited number of additional NWHI trips from the NMFS market monitoring data set. The HDAR integrated data set captures the Kauai-based (Mau zone) segment of the NWHI fishing fleet which was previously difficult to monitor. Use of the data sets in combination provides good coverage of the activities of the NWHI bottomfish fleet. It also provides opportunities for the cross-checking of trip and landing information.

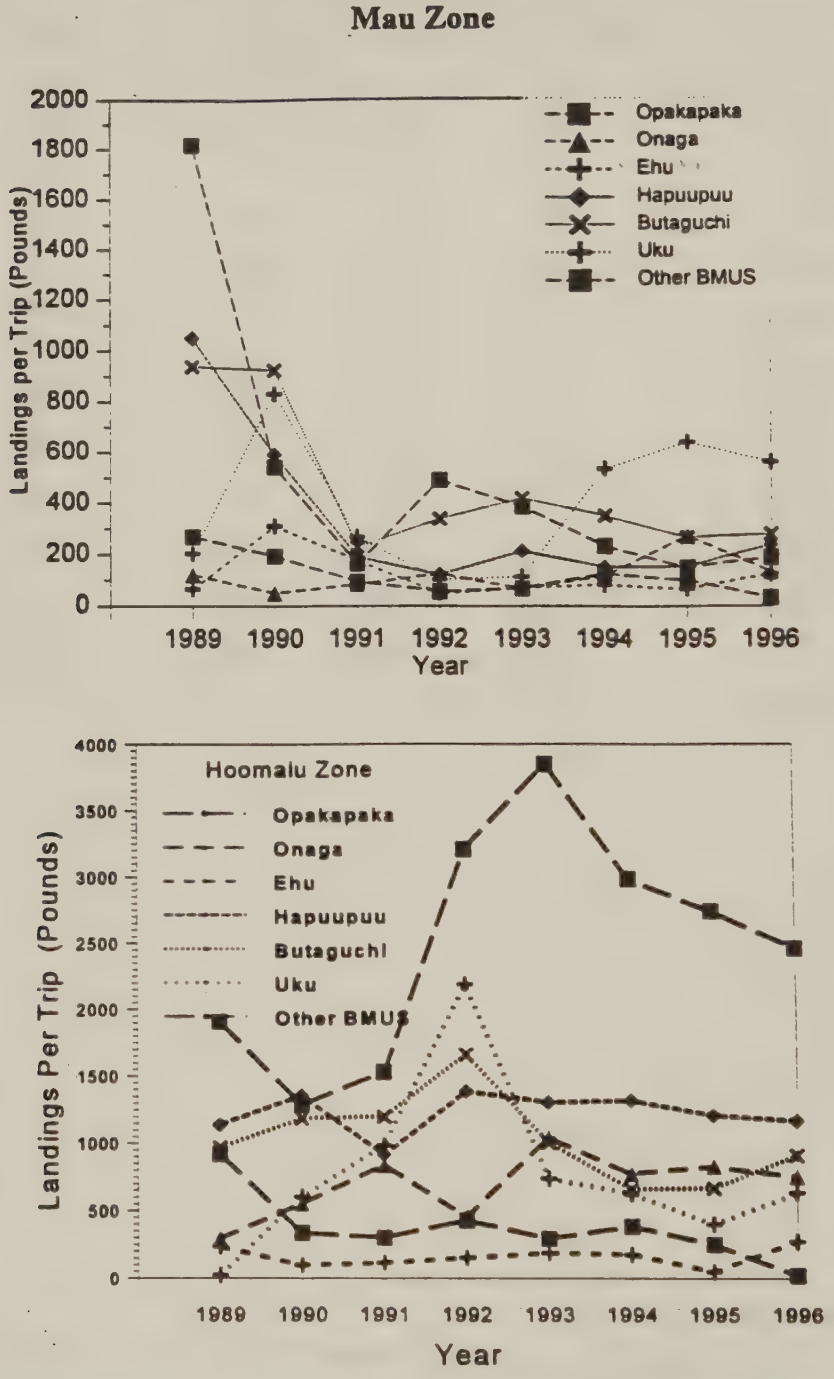
Year	Landings (1000 lb)				
	Mau	Hoomalu	Total NWHI[1]	MHI[2]	Total Hawaii
1984	NA	NA	661	807	1,481
1985	NA	NA	922	763	1,717
1986	NA	NA	869	810	1,682
1987	NA	NA	1,015	785	1,818
1988	NA	NA	626	1,166	1,794
1989	118	184	303	1,007	1,314
1990	249	173	421	651	1,094
1991	103	283	387	562	983
1992	71	353	424	588	1,043
1993	98	287	385	462	862
1994	160	283	443	536	1,011
1995	166	202	369	568	969
1996[3]	135	176	311	421	747

1 NWHI data from NMFS for 1984-1990 and from combination of NMFS & HDAR for 1991-96.

2 MHI data from HDAR.

3 Preliminary data

Figure 2. Northwestern Hawaiian Islands BMUS species composition of landings per trip, by weight, for the Mau and Hoomalu Zones



Interpretation: Mau zone per trip landings of BMUS species had been steadily rising from 1992 through 1995 but has declined back to 1994 levels in 1996. The increase in the onaga landings seen last year have since declined in 1996. This decrease is probably not due to any stock related problems but rather due to a physiological condition of the larger onaga that were being caught. This condition appears to be similar to "tuna burn". Many of the large (>20 pounds) onaga have been affected by this condition. The flesh of a large percentage of the large onaga appear whitish as though they have been "cooked". The low value associated with this quality of flesh has caused fishermen to target opakapaka instead. Opakapaka landings have shown an increase in 1996. There has been no occurance of "burn" in this or any other bottomfish species at this time. The cause of the "burn" is not known.

Hoomalu zone per trip landings have been slowly declining since the 1992 uku run but have not hit pre-1992 levels. The 1996 BMUS catch per trip has declined for opakapaka and onaga while ehu, butaguchi and uku sustained large increases. There were only 3 vessels that fished in the Hoomalu zone in 1996. All of them did so on a full-time basis with catch per trip remaining nearly identical.

Source: The 1996 data are mainly from HDAR and supplemented from the NMFS market monitoring program.

Calculation & Adjustment: The HDAR integrated data set was supplemented with additional NWHI trips from the NMFS data set. The BMUS data were totaled by zone and divided by the number of trips to each zone. The 1995 data have been updated.

NWHI BMUS average pounds per trip by species, Mau Zone

Species	1989	1990	1991[1]	1992[1]	1993[1]	1994[1]	1995[1]	1996[1]
Opakapaka	1,820	541	163	488	382	229	149	187
Onaga	120	49	83	124	66	114	270	132
Ehu	65	309	176	48	69	81	65	123
Hapuupuu	1,050	590	189	121	210	150	153	235
Butaguchi	938	923	228	336	415	346	264	276
Uku	202	830	266	100	112	529	635	558
Other BMUS	268	193	94	56	67	124	99	32
Total per trip	4,463	3,435	1,199	1,273	1,321	1,573	1,635	1,543

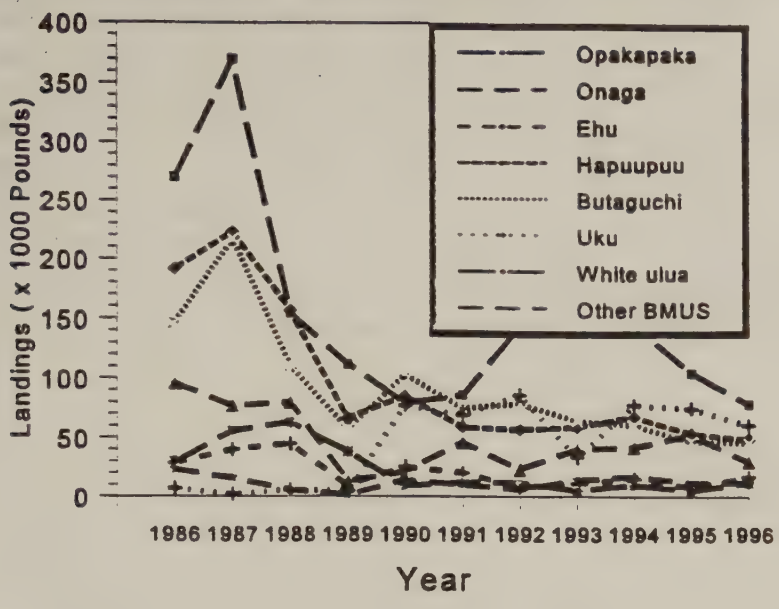
[1] Data from combination of NMFS and HDAR data sets.

NWHI BMUS average pounds per trip by species, Hoomalu Zone

Species	1989	1990	1991[1]	1992[1]	1993[1]	1994[1]	1995[1]	1996[1]
Opakapaka	1,910	1,284	1,530	3,208	3,849	2,984	2,741	2,426
Onaga	293	550	837	450	1,042	771	825	752
Ehu	231	94	113	148	185	172	47	272
Hapuupuu	1,138	1,357	913	1,386	1,305	1,318	1,206	1,166
Butaguchi	969	1,185	1,196	1,660	1,004	655	665	909
Uku	20	600	985	2,187	736	623	397	632
Other BMUS	920	333	297	425	291	380	249	21
Total per trip	5,481	5,403	5,871	9,464	8,412	6,903	6,130	6,216

[1] Data from combination of NMFS and HDAR data sets.

Figure 3. NWHI BMUS species composition of landings by weight



Interpretation: The overall trends of the NWHI bottomfish landings are on a decline. The general trend of decreasing landings in 1996 may be a reflection of the decreasing number of trips as the landings per trip has remained nearly the same as in 1995. Opakapaka landings show the largest decline while ehu and white ulua were the only species to show an increase in 1996.

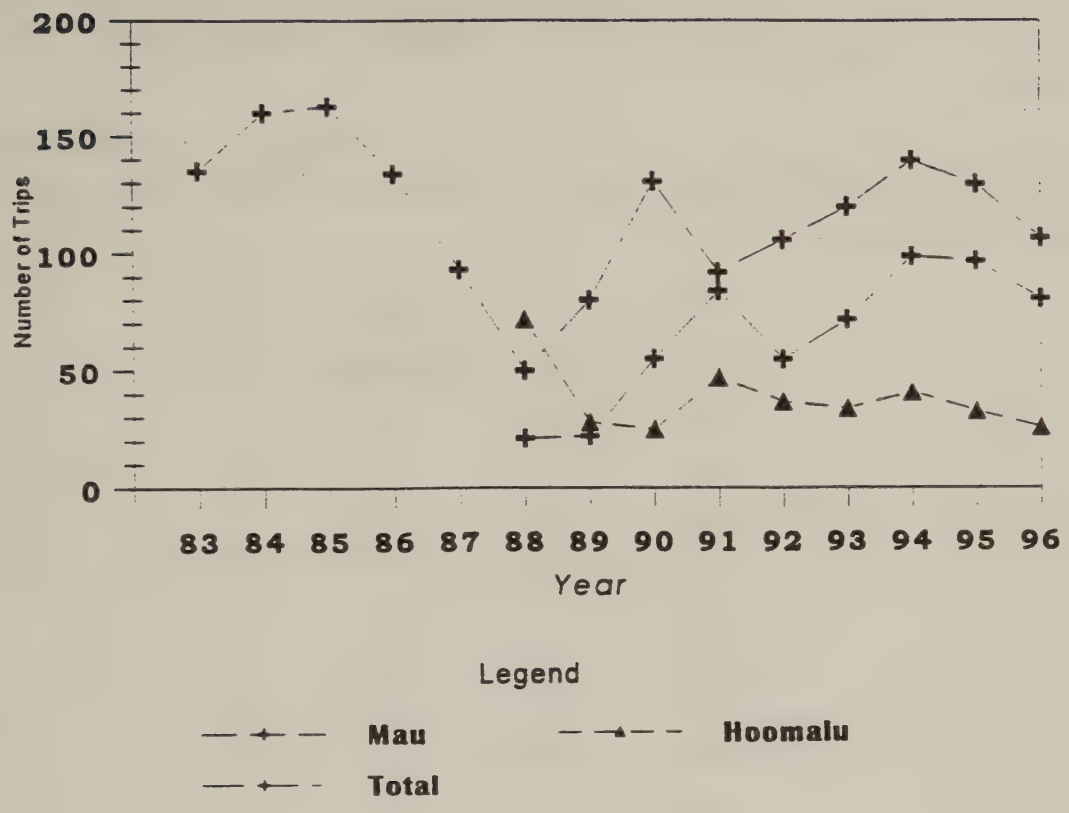
Source: Data for 1996 is mainly from the HDAR integrated data set and supplemented with data from the NMFS market monitoring program. Data for 1991-1995 are from a combination of HDAR and NMFS market monitoring program. Data from 1987-1990 are expanded NMFS estimates.

Calculation & Adjustment: HDAR data was supplemented with additional NWHI trips from the NMFS market data set. The 1995 data has been updated.

Species	1986	1987	1988	1989	1990	1991[1]	1992[1]	1993[1]	1994[1]	1995[1]	1996
Opakapaka	270	370	154	112	79	86	145	158	145	105	7
Onaga	96	77	80	13	21	46	23	40	42	53	3
Ehu	28	40	45	9	25	20	8	11	15	8	1
Hapuupuu	191	223	156	66	85	59	57	59	68	54	4
Butaguchi	146	217	111	57	103	75	79	64	61	47	4
Uku	7	2	6	5	77	69	86	33	78	75	6
White ulua	29	56	63	38	9	12	12	5	10	5	1
Other BMUS	23	16	6	1	14	10	6	14	17	12	1

[1] Data from a combination of NMFS and HDAR data.

Figure 4. Number of trips made by NWHI bottomfish fleet, Mau and Hoomalu Zones
Interpretation: The overall trend in the number of trips to the NWHI areas is one of decrease



since 1994. The number of vessels fishing in the access restricted Hoomalu zone had remained relatively constant at 4-6 vessels per year since 1989 when the limited entry plan went into effect but has dwindled to 3 in 1996. The decrease in the number of trips to the Hoomalu zone in 1995 is due to the fact that only 3 of the vessels fished in 1996. These 3 vessels did fish on a full time basis. The average number of trips per vessel has risen back to 8 after having dropped to 5 in 1995. The drop to 5 after having averaged 8 per year in 1993-94 was due to the effect of the part-time vessels in the fishery.

The number of trips to the Mau zone also dropped in 1996 but remains above those of the 1989-1993 seasons. The number of trips have rebounded after the low point in 1992 after Hurricane Iniki. Additional trip data from HDAR beginning in 1991 has enhanced the accuracy of the data. The implementation of the daily trip report for the NWHI bottomfish fishery by the State has resulted in the most complete data set with much improved accuracy. Trips by the Mau zone

fleet home-ported on Kauai can now be accurately assessed. Many of these were previously missed using only the NMFS market monitoring system.

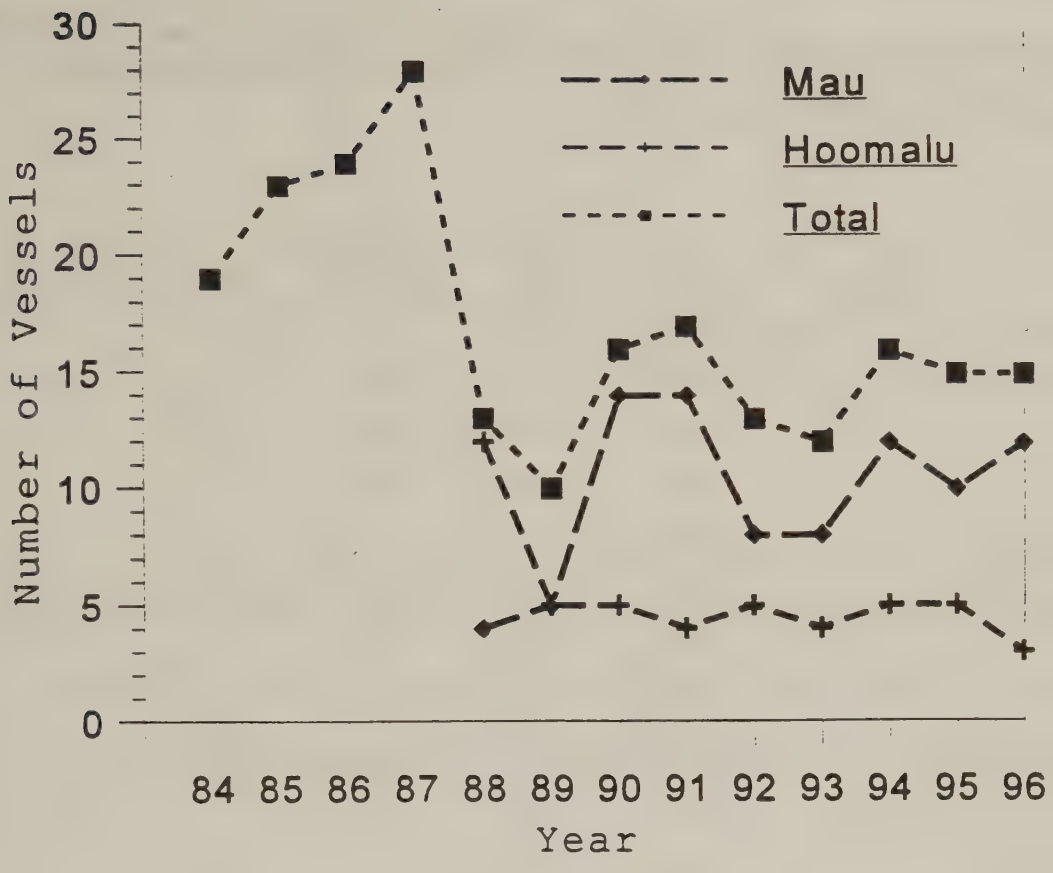
Source: Data for 1996 was primarily from HDAR supplemented with NMFS data on an as needed basis. Data for 1991-1995 are from a combination of HDAR and NMFS market monitoring program and the HDAR fast-track data system. Data from 1986-1990 are NMFS estimates.

Calculation & Adjustment: HDAR trip data was supplemented with additional NWHI trips from the NMFS market monitoring program. The data for 1995 have been updated. The trips were totaled by area fished.

	Trips		
Year	**Mau**	**Hoomalu**	**Total**
1984	NA	NA	135
1985	NA	NA	160
1986	NA	NA	163
1987	NA	NA	134
1988	21	72	93
1989	22	28	50
1990	55	25	80
1991[1]	84	47	131
1992[1]	55	37	92
1993[1]	72	34	106
1994[1]	99	41	140
1995	97	33	130
1996	81	26	107

[1] **Based on combined NMFS and HDAR data.**

Figure 5. Number of vessels in the NWHI bottomfish fleet, Mau and Hoomalu Zones



Interpretation: The overall trend in the number of vessels fishing in the NWHI areas has remained nearly level for the last 3 years. The number of vessels fishing in the access restricted Hoomalu zone has dropped to 3 full-time vessels in 1996. It had remained relatively constant at 4-6 vessels per year (includes part-time vessels) since 1989 when the limited entry plan went into effect. There was speculation that the number of vessels would rise in 1995 due to the effect of the grandfather time period coming to a close at the end of 1994 but the 3 additional grandfather vessels did not fish the 1995 season. They did not subsequently enter the fishery in 1996.

The Mau zone has been the more dynamic zone in terms of vessel participation. The open access designation has allowed many vessels to acquire permits and fish this area. The number of vessels in the Mau zone increased in 1996 to 13. Additional data from HDAR beginning in 1991 has greatly enhanced the accuracy of the data. The Mau zone fleet home-ported on Kauai are now easily identified and monitored.

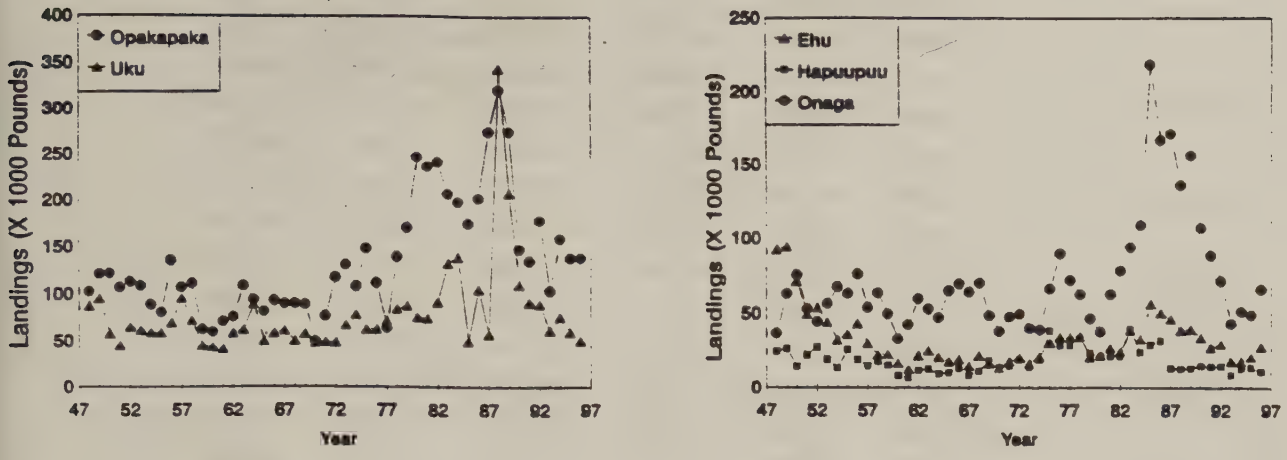
Source: Data for 1996 was primarily from HDAR supplemented with data from the NMFS. Data for 1991-1995 are from a combination of HDAR and NMFS market monitoring program and the HDAR fast-track data system. Data from 1984-1990 are NMFS estimates.

Calculation & Adjustment: NMFS vessel data was supplemented with all additional NWHI vessels from the HDAR fast-track system. The data for 1995 have been updated. The number of vessels were totaled by area fished.

	Boats		
Year	Mau	Hoomalu	Total[2]
1984	NA	NA	19
1985	NA	NA	23
1986	NA	NA	24
1987	NA	NA	28
1988	4	12	13
1989	5	5	10
1990	14	5	16
1991[1]	14	4	17
1992[1]	8	5	13
1993[1]	8	4	12
1994[1]	12	5	16
1995[1]	10	5	15
1996[1]	12	3	15

[1] Based on a combination NMFS and HDAR data set.
[2] Total may not match sum of areas due to vessel participation in multiple areas.

Figure 6. MHI species composition of landings by weight



Interpretation: Most species show declining trends continuing from the mid- and late-eighties. The prevailing interannual pattern in landings is episodic versus predictably periodic or constant.

Source: Total commercial landings by species are from HDAR commercial catch report data.

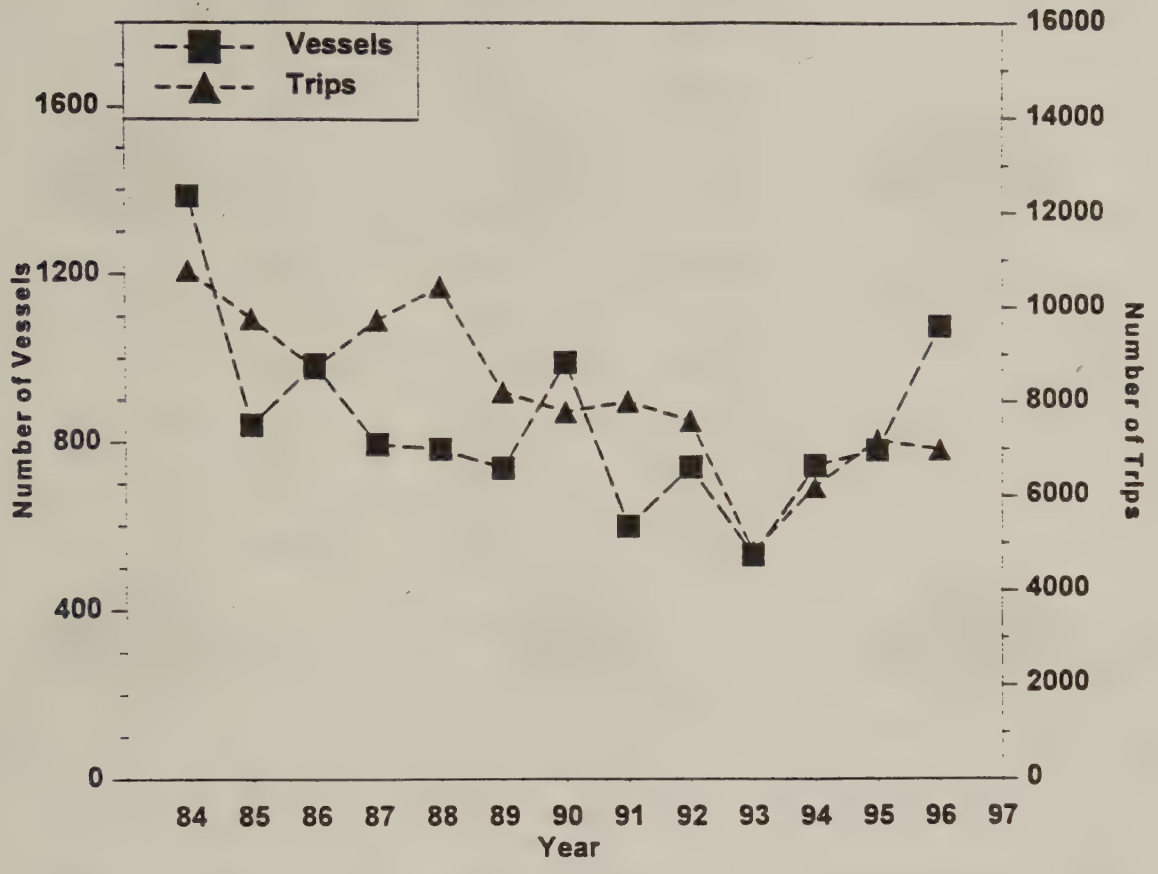
Comments: Does not include any expansion for recreational landings. The values for 1996 are preliminary estimates.

MHI Landings by Species

Year	OPA	UKU	EHU	HAP	ONA
1948	102,651	87,235	92,323	24,609	36,804
1949	121,243	95,273	94,097	26,397	62,979
1950	121,664	57,814	71,286	14,514	75,398
1951	106,423	45,065	49,699	22,000	53,018
1952	112,917	64,799	53,716	27,499	44,604
1953	108,504	61,619	44,200	19,009	56,506
1954	88,641	58,767	32,278	13,367	67,583
1955	80,516	58,564	36,017	25,849	63,208
1956	134,980	69,108	43,313	19,224	75,986
1957	106,656	95,267	30,157	14,782	53,988
1958	111,131	71,321	22,309	18,033	63,774
1959	62,043	44,705	23,107	15,294	49,745
1960	59,405	43,186	16,950	8,418	33,158

1961	70,083	41,134	12,370	6,642	42,701
1962	75,492	57,568	21,742	11,663	59,788
1963	108,505	61,601	25,267	12,865	53,225
1964	93,618	89,156	20,914	9,321	47,325
1965	81,039	49,485	17,605	10,297	65,040
1966	92,815	57,849	19,342	13,277	69,634
1967	89,364	60,970	14,899	8,480	64,022
1968	89,908	49,677	21,984	11,287	69,922
1969	88,621	57,542	16,483	18,300	48,454
1970	49,655	47,443	13,364	13,651	37,894
1971	76,388	48,710	17,626	14,746	47,250
1972	117,367	48,077	20,347	18,994	49,213
1973	130,785	66,875	16,336	13,878	39,811
1974	107,828	77,939	21,015	18,874	38,883
1975	147,755	62,117	30,155	38,140	66,029
1976	111,520	62,165	33,788	28,214	89,518
1977	163,813	71,915	33,689	28,540	71,747
1978	138,931	83,798	34,333	33,271	62,208
1979	170,180	87,128	20,339	23,538	46,271
1980	247,378	74,782	21,712	20,962	37,489
1981	237,254	73,921	26,900	21,178	62,351
1982	241,977	90,793	24,542	21,263	78,372
1983	207,345	131,860	38,793	39,447	94,082
1984	198,260	138,313	33,022	24,019	109,046
1985	174,746	49,264	56,039	29,055	218,552
1986	202,467	104,047	50,259	31,626	167,112
1987	274,929	56,753	46,018	13,232	171,416
1988	320,601	344,128	38,547	12,838	136,641
1989	275,167	208,171	39,393	12,954	156,952
1990	146,861	108,840	33,848	14,934	107,514
1991	134,326	90,272	26,902	14,216	88,978
1992	178,014	88,474	29,461	14,454	71,715
1993	102,514	60,910	17,981	8,593	43,141
1994	158,276	72,133	18,000	12,712	51,502
1995	137,473	59,036	20,689	13,819	48,948
1996	**137,755**	**49,808**	**27,644**	**10,895**	**66,191**

Figure 7. Standardized MHI bottomfishing trips & vessels



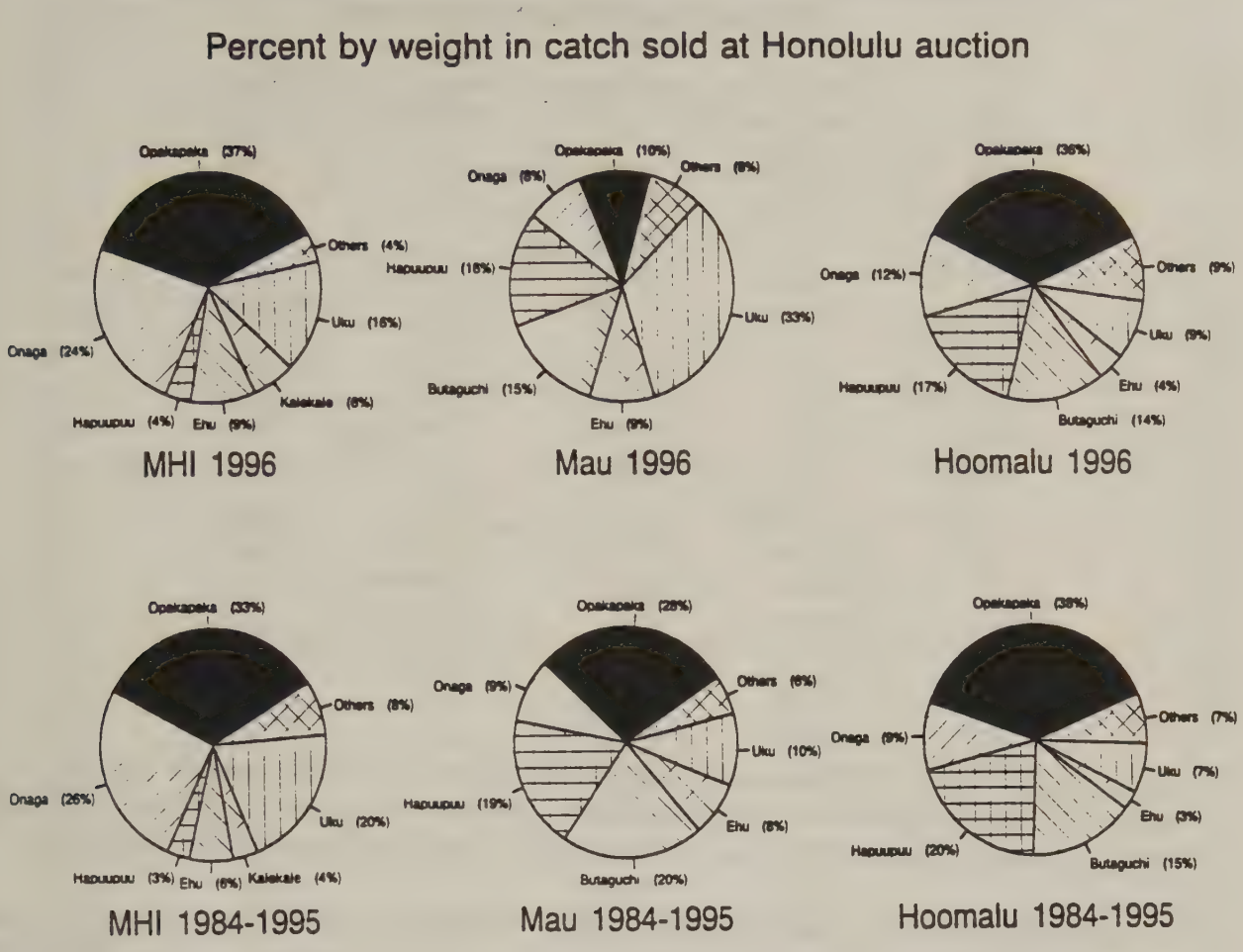
Interpretation: Effort remained similar to 1995 whereas participation in the MHI fishery continued to increase in 1996.

Source: Fishing effort and vessels estimates based on commercial HDAR C-3 catch report data.

Calculation & Adjustment: MHI trips and vessels estimated from annual total MHI bottomfish landings, mean CPUE, and mean total landings per vessel. These estimates represent standardized units of Maui-Molokai-Lanai-Kahoolawe (MLMK) bottomfishing trips and vessels as applied to the entire MHI region. The MLMK criteria for MHI CPUE are described in Fig. 15-A. All values have changed slightly from previous year's reports due to modifications in the calculation. A preliminary expansion factor is used to estimate unreported recreational landings (from Hamm and Lum, 1992). Effort estimates are based on calendar year and are essentially complete for 1996 whereas the participation estimates are based on fiscal year (due to the need to track individual license numbers) and are incomplete for 1996.

Year	Trips	Vessels
1984	10,769	1,386
1985	9,747	841
1986	8,682	985
1987	9,719	797
1988	10,415	785
1989	8,190	739
1990	7,764	992
1991	7,991	601
1992	7,574	742
1993	4,813	532
1994	6,190	747
1995	7,182	784
1996	6,987	1,079

Figure 8. Current year and historical catch composition by weight in sold catch.

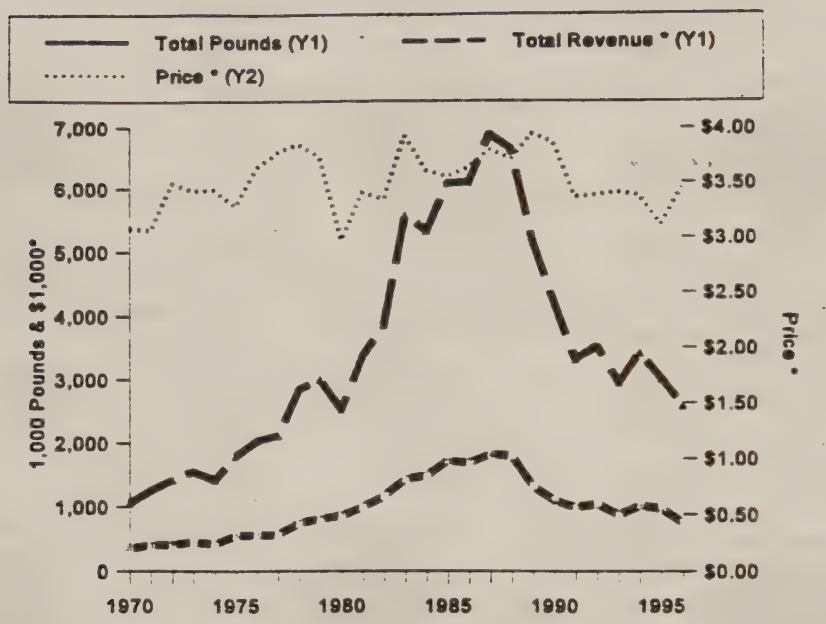


Interpretation: The 1996 pattern closely resembles the historical pattern in the MHI and Hoomalu zone. Mau zone opakapaka became a smaller component of the catch whereas uku became a much larger component of the catch in 1996.

Source: Catch composition estimated from Honolulu auction data.

Comments: Reflects only auction-sold fish, and does not include fish that are kept, given away, or sold at other locations. "Others" in the MHI include butaguchi, gindai, white ulua, lehi, and taape. "Others" in the NWHI include kalekale, gindai, white ulua, lehi, and taape.

Figure 9. Hawaii domestic bottomfish landings and revenue (* adjusted for inflation), 1970-present.



Interpretation: *Real* (* inflation-adjusted) ex-vessel revenue from the Hawaii domestic bottomfish fishery peaked in 1987 and has declined by over 50% since then. The mid- to late-1980s were also the period of highest inflation-adjusted aggregate average ex-vessel prices.

The decline of Hawaii bottomfish landings and ex-vessel revenue is dramatic in both nominal and inflation-adjusted terms. Total landings (NWHI and MHI combined) have declined by 59%, nominal revenue by 47%, and inflation-adjusted revenue by 63% (which is below its long-term average). Nominal ex-vessel price per pound has risen by 17% since the mid-1980s, but inflation-adjusted prices have fallen 12% (still at its long-term average).

Landings and ex-vessel revenue from both the NWHI and the MHI have fallen during the period (see subsequent table). The NWHI decline in landings mirrors a decline in the number of trips and days fished per trip (particularly in the Mau zone). The MHI decline appears to represent the decline in catch rates.

Hawaii domestic bottomfish landings and revenue(adjusted for inflation), 1970-present.

Year	Total Pounds (1,000)	Total Revenue ($1,000)	Inflation-adjusted Revenue ($1,000)	Average Price per Pound	Inflation-adjusted Average Price per Pound	Honolulu Consumer Price Index
1970	344	$253	$1,055	$0.74	$3.07	114
1971	410	312	1.249	$0.76	$3.05	119

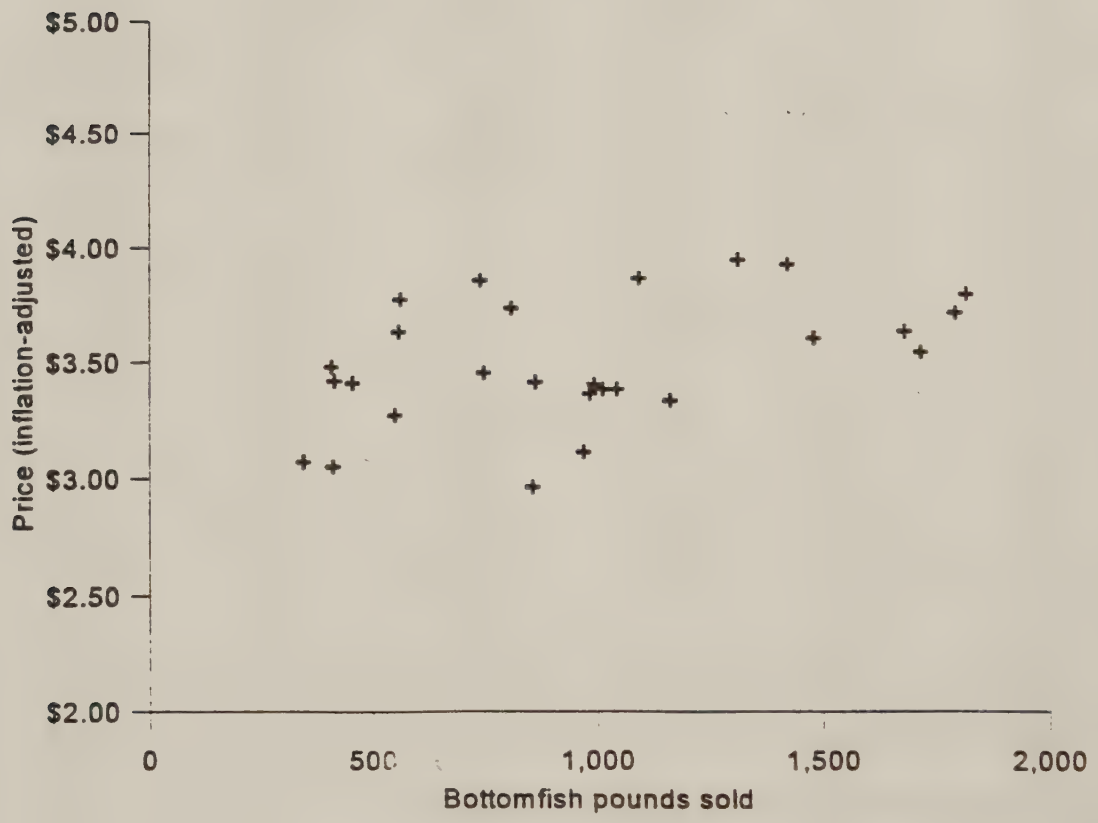
1972	407	366	1,419	$0.90	$3.48	123
1973	454	418	1,551	$0.92	$3.41	128
1974	413	421	1,412	$1.02	$3.42	142
1975	549	584	1,793	$1.06	$3.27	155
1976	558	693	2,026	$1.24	$3.63	163
1977	562	764	2,117	$1.36	$3.77	172
1978	740	1,100	2,844	$1.49	$3.85	184
1979	809	1,296	3,016	$1.60	$3.73	205
1980	856	1,218	2,535	$1.42	$2.96	229
1981	993	1,794	3,377	$1.81	$3.40	253
1982	1,162	2,177	3,865	$1.87	$3.33	268
1983	1,424	3,233	5,578	$2.27	$3.92	276
1984	1,481	3,192	5,335	$2.16	$3.60	285
1985	1,717	3,853	6,085	$2.24	$3.54	301
1986	1,682	3,958	6,113	$2.35	$3.63	308
1987	1,818	4,687	6,890	$2.58	$3.79	324
1988	1,794	4,796	6,655	$2.67	$3.71	343
1989	1,314	3,867	5,172	$2.94	$3.94	356
1990	1,094	3,371	4,219	$3.08	$3.86	380
1991	983	2,863	3,308	$2.91	$3.36	412
1992	1,043	3,199	3,525	$3.07	$3.38	432
1993	862	2,749	2,941	$3.19	$3.41	445
1994	1,011	3,277	3,421	$3.24	$3.38	456
1995	969	2,949	3,012	$3.04	$3.11	466
1996	747	2,577	2,577	$3.45	$3.45	476
Average	970	2,221	3,448	$2.05	$3.50	278
Standard Deviation	455	1,464	1,750	$0.88	$0.27	120

Data: Hawaii Division of Aquatic Resources (HDAR) commercial catch reports are utilized for all Main Hawaiian Islands (MHI) landings and revenue. HDAR reports are also used for pre-1984 Northwestern Hawaiian Islands (NWHI) landings. NWHI landings since 1984 are from the NMFS Honolulu Laboratory's fishery monitoring program (combined with HDAR figures for 1991-present). Inflation-adjusted values are to 1996 base. *Total* Hawaii landings may not equal MHI + NWHI due to domestic bottomfish landings in Hawaii from "Other" areas. "Other" areas include various U.S. possessions in the central Pacific (e.g., Palymra), as well as landings where the area was not recorded.

Revenue is adjusted for inflation by the ratio of the Honolulu Consumer Price Index (HCPI) for the current year (1996) to each year in the time series.

Data source: B8796N.cal (5/9/97) & HTOT96A.cal (5/17/97)

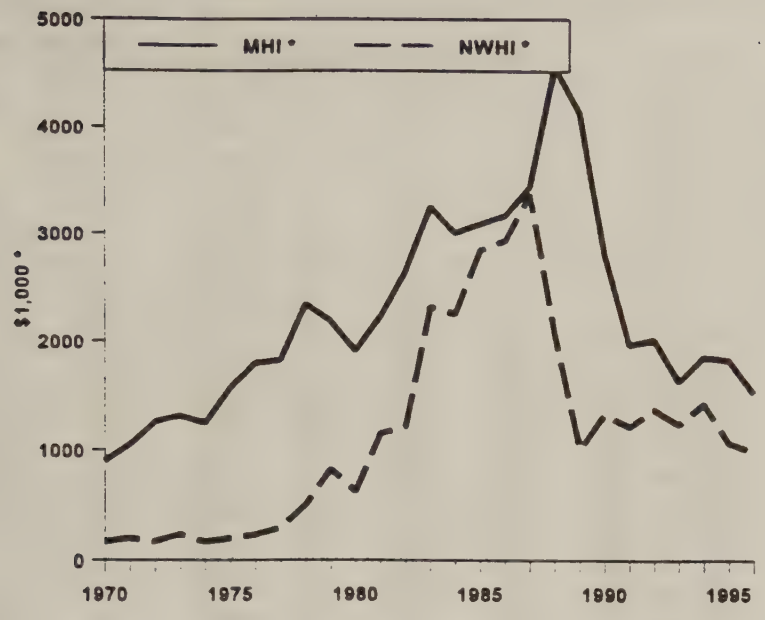
Figure 10. Hawaii bottomfish market (annual * inflation-adjusted ex-vessel prices and domestic landings), 1970-96.



Interpretation: Economic research in the mid-1980s showed a considerable (negative) relationship between price (* inflation-adjusted) and landings on a weekly basis, but this relationship is not shown for annual data. Despite the substantial decline in domestic landings, real prices have not risen. Thus the market for Hawaii bottomfish appears weaker, perhaps due to an increase in imported bottomfish from South Pacific island nations. Markets for particular species have improved, as shown by a later table on species prices. (Inflation-adjusted values are to 1996 base.)

Data: see previous figure.

Figure 11. Hawaii bottomfish landings and revenue* by source, 1970-present (* Inflation-adjusted)



Interpretation: The rise in ex vessel revenue (adjusted for inflation) for both the MHI and the NWHI to their peaks in 1985-1988 was from both the development of the Northwestern Hawaiian Islands in the early 1980s (following increased research by NMFS, HDAR, and the University of Hawaii in the 1970s) and the growth of the Main Hawaiian Islands fishery. The local market for bottomfish also expanded at that time, and bottomfish (primarily *opakapaka*) became an important restaurant item. During periods of abundance, fresh bottomfish was exported to the mainland U.S.

Both MHI and NWHI inflation-adjusted revenues are now less than a third what they were in 1988. The inflation-adjusted revenue of the MHI fishery is the lowest since 1974 and the NWHI fishery is at its lowest since 1980 (prior to development).

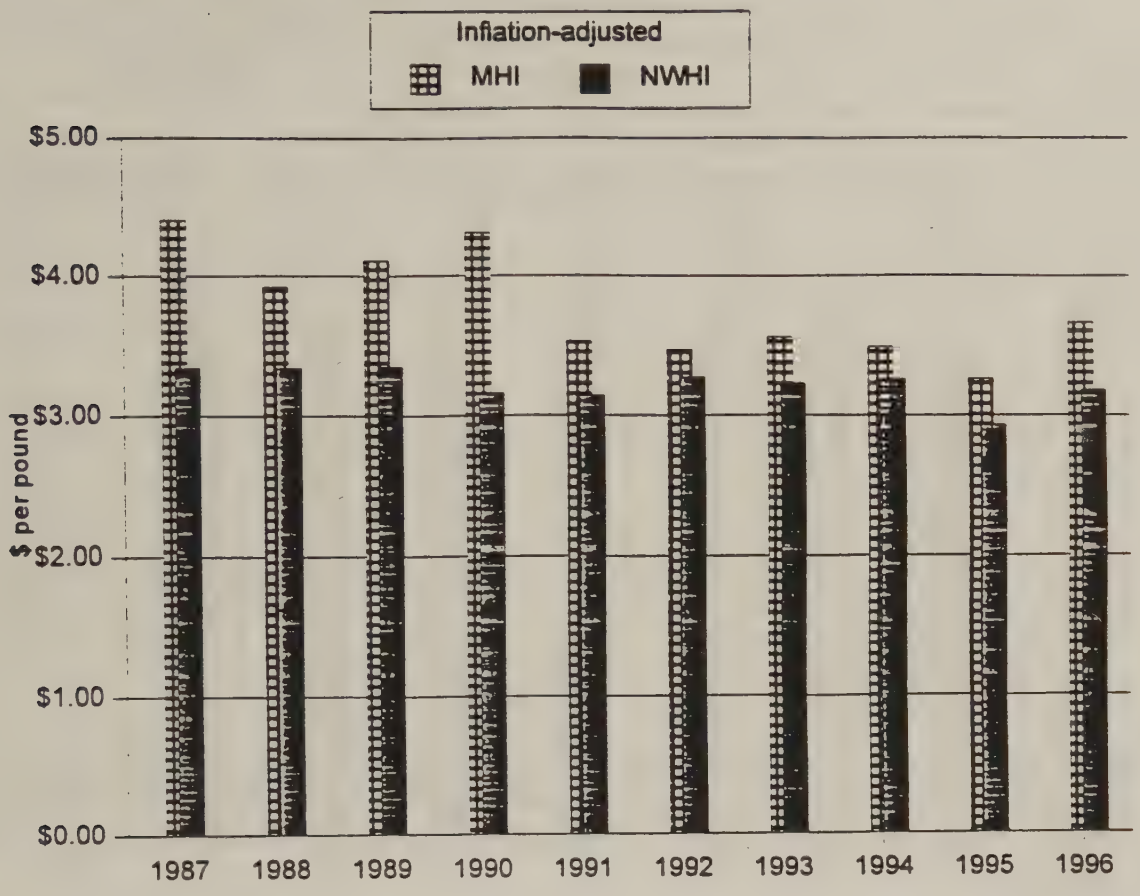
Hawaii bottomfish landings and revenue* by source, 1970-present
(* Inflation-adjusted)

	NWHI	MHI	NWHI *	MHI *
			Inflation-adjusted	
Year	Pounds landed		ex-vessel revenue	
1970	74	270	163	894
1971	75	335	201	1,051
1972	43	364	163	1,258
1973	62	392	234	1,320
1974	49	364	165	1,250
1975	59	485	197	1,578
1976	59	499	228	1,802
1977	83	479	289	1,832
1978	143	597	503	2,347
1979	229	580	829	2,192
1980	316	541	624	1,916
1981	402	591	1,152	2,232
1982	488	673	1,218	2,654
1983	575	847	2,326	3,253
1984	661	803	2,261	3,009
1985	922	765	2,848	3,092
1986	869	811	2,940	3,175
1987	1,015	785	3,387	3,454
1988	625	1,166	2,085	4,571
1989	303	1,007	1,013	4,141
1990	423	616	1,337	2,811
1991	387	562	1,217	1,981
1992	424	588	1,385	2,034
1993	385	462	1,247	1,644
1994	443	536	1,444	1,873
1995	369	568	1,081	1,848
1996	311	421	993	1,540
Average	363	596	1,168	2,250
Standard Deviation	279	209	936	928

Data: Hawaii Division of Aquatic Resources (HDAR) commercial catch reports are utilized for all Main Hawaiian Islands (MHI) landings and revenue. HDAR reports are also used for pre-1984 Northwestern Hawaiian Islands (NWHI) landings. NWHI landings since 1984 are from the NMFS Honolulu Laboratory's fishery monitoring program. *Total* Hawaii landings may not equal MHI + NWHI due to domestic bottomfish landings in Hawaii from "Other" areas. Inflation-adjusted values are to 1996 base.

Data source: B8796N.cal (5/4/97) & HTOT96A.cal (5/12/97)

Figure 12. Hawaii Bottomfish Ex-vessel Prices by source, 1987-present
(Prices adjusted for inflation to 1996 base)



Interpretation: Ex-vessel aggregate bottomfish prices show the continued preference for main Hawaiian Islands (MHI) bottomfish on average (an approximately 15% difference), although species composition may affect the year-to-year change in weighted averages. Average prices for most species landed from the MHI exceed those landed from the NWHI. This is largely due to freshness and market size preferences. Imports of bottomfish from South Pacific island areas are believed to be playing a larger role in the Hawaii market, but U.S. Customs data does not provide sufficient detail to make such a comparison.

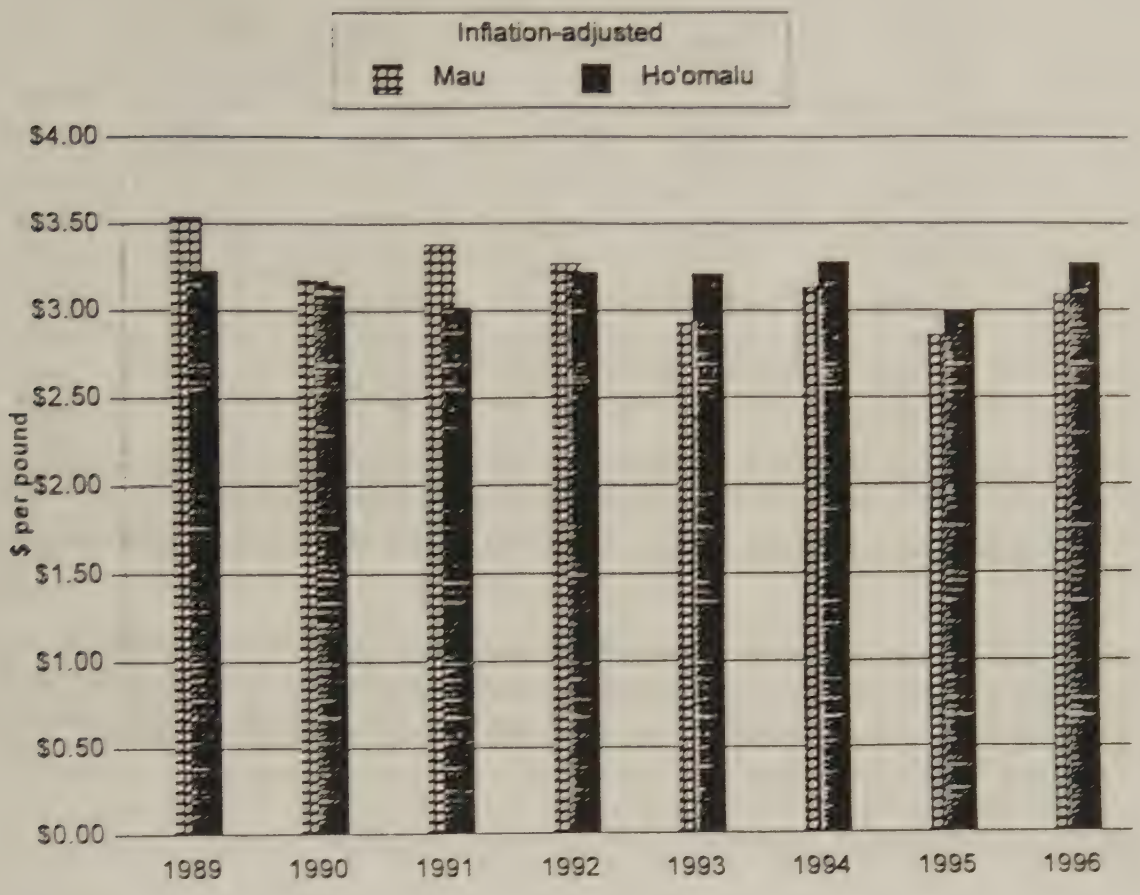
Hawaii Bottomfish Ex-vessel Prices by Source, 1987-present.

	Nominal Price per Pound (ex vessel)			Inflation-adjusted Price per Pound			
Year	Total Hawaii	MHI	NWHI	Total Hawaii	MHI	NWHI	HCPI
1987	$2.58	$2.99	$2.27	$3.79	$4.40	$3.34	324
1988	$2.67	$2.82	$2.40	$3.70	$3.91	$3.33	343
1989	$2.94	$3.07	$2.50	$3.93	$4.11	$3.34	356
1990	$3.08	$3.44	$2.52	$3.85	$4.31	$3.15	380
1991	$2.91	$3.05	$2.72	$3.36	$3.52	$3.14	412
1992	$3.07	$3.14	$2.96	$3.38	$3.46	$3.26	432
1993	$3.19	$3.32	$3.02	$3.41	$3.55	$3.23	445
1994	$3.24	$3.34	$3.12	$3.38	$3.49	$3.26	456
1995	$3.04	$3.19	$2.87	$3.11	$3.26	$2.93	466
1996	$3.45	$3.66	$3.18	$3.45	$3.66	$3.18	476
Average	$3.02	$3.20	$2.76	$3.54	$3.77	$3.22	409
Standard Deviation	$0.26	$0.24	$0.32	$0.27	$0.39	$0.12	54.80

Data: MHI prices are compiled from HDAR commercial catch reports. NWHI prices are compiled from NMFS market monitoring. *Total* Hawaii prices are a weighted average of MHI & NWHI revenue and pounds landed (not necessarily pounds sold). Inflation-adjusted values are to 1996 base.

Data source: B8796N.cal (5/4/97)

Figure 13. Hawaii Bottomfish Ex-vessel Prices by NWHI zone, 1989-present (Inflation-adjusted prices to 1996 base)



Interpretation: Ho'omalu zone bottomfish prices are marginally greater than Mau zone prices (approximately 5%), despite the longer distance and trips Ho'omalu zone vessels take. This probably reflects species composition (a higher percentage of opakapaka and onaga in the Ho'omalu zone landings) as well as larger sizes.

Hawaii Bottomfish Ex-vessel Prices by NWHI zone, 1989-present
(Inflation-adjusted prices to 1996 base)

	Nominal Price per Pound		Inflation-adjusted Price		
Year	**Mau**	**Ho'omalu**	**Mau**	**Ho'omalu**	**HCPI**
1989	$2.64	$2.41	$3.53	$3.22	356
1990	$2.53	$2.51	$3.17	$3.14	380
1991	$2.92	$2.61	$3.37	$3.02	412
1992	$2.96	$2.92	$3.26	$3.22	432
1993	$2.73	$2.99	$2.92	$3.20	445
1994	$2.99	$3.14	$3.12	$3.28	456
1995	$2.80	$2.94	$2.86	$3.00	466
1996	$3.09	$3.27	$3.09	$3.27	476
Average	$2.83	$2.85	$3.17	$3.17	428
Standard Deviation	$0.19	$0.31	$0.22	$0.11	42.36

Data: MHI prices are compiled from HDAR commercial catch reports. NWHI prices are compiled from NMFS market monitoring. *Total* Hawaii prices are a weighted average of MHI & NWHI revenue and pounds landed (not necessarily pounds sold). Inflation-adjusted values are to 1996 base.

Data source: B8796N.cal (5/4/97)

Table 4. Hawaii Bottomfish Market Ex-vessel Prices by Species, 1995 and 1996

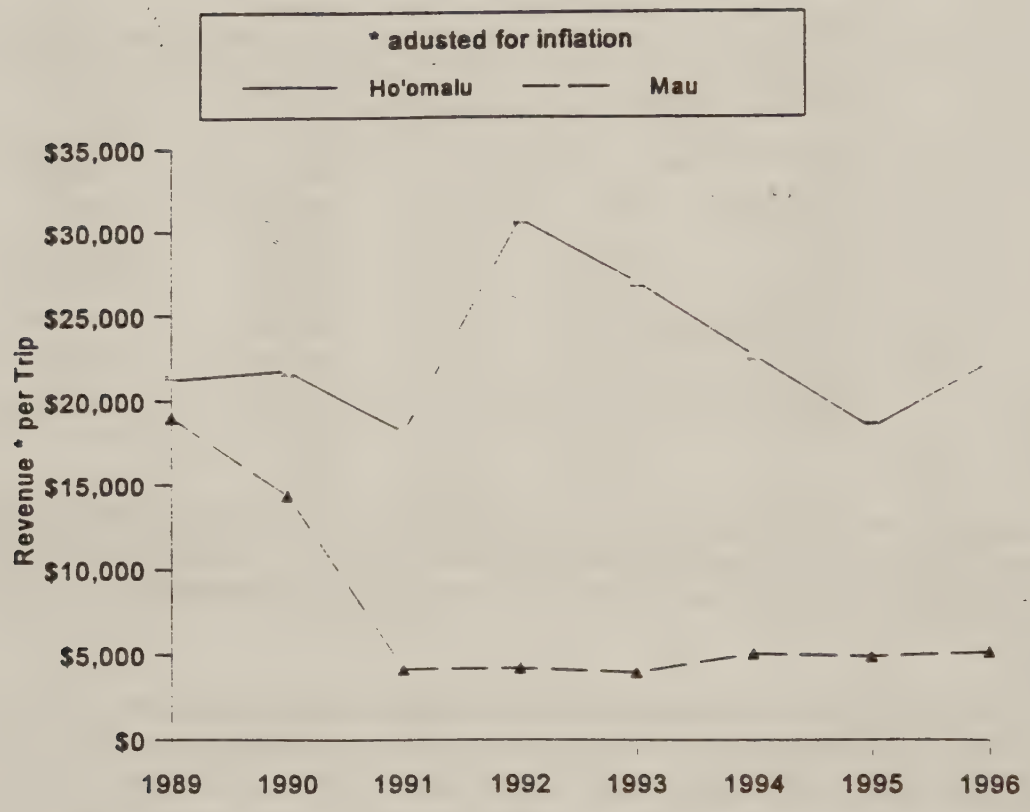
Species	1995	1996
Butaguchi	$1.69	$1.87
Ehu	$3.99	$3.90
Hapuupuu	$2.99	$3.31
Onaga	$4.94	$5.94
Opakapaka	$3.65	$4.31
Uku	$2.72	$2.64
Other BMUS	$1.37	$1.65
Other Bottomfish	$1.72	$1.94
Imports	$1.80	$2.49
Total	$3.04	$3.10

Interpretation: The data show the increasing preference for opakapaka and onaga, the *name* red snappers, while other bottomfish prices were relatively stable. The price of imported bottomfish was higher in 1996, increasing the market average. It is likely that species composition affects this price.

Data: Hawaii Division of Aquatic Resources (HDAR) commercial catch reports are utilized for all Main Hawaiian Islands (MHI) landings and revenue. HDAR reports are also used for pre-1984 Northwestern Hawaiian Islands (NWHI) landings. NWHI landings since 1984 are from the NMFS Honolulu Laboratory's fishery monitoring program. Data are combined to provide Hawaii totals. *Total* Hawaii ex-vessel prices are a weighted average of MHI & NWHI revenue and pounds landed (not necessarily pounds sold). *Other BMUS* are other Bottomfish Management Unit Species.

Data source: B8796N.cal (5/4/97))

Figure 14. NWHI Bottomfish inflation-adjusted revenue * per trip by zone, 1989-present.



Interpretation: There has been relative stability in the limited entry zone (Ho'omalu) in terms of per trip inflation-adjusted ex-vessel revenue over the past 8 years (as shown by current returns being similar to the long-term average and the smaller standard deviation). The 1990-91 decline in Mau zone per trip revenue reflects the closure of the zone to the Ho'omalu zone limited entry vessels and the increasingly part-time and small-scale nature of the open access zone. Activity in the Ho'omalu zone has declined in terms of number of trips (26 trips in 1996) compared to the early 1990s (37 trips in 1992).

Interestingly, inflation-adjusted average aggregate bottomfish ex-vessel prices from the Mau zone have declined substantially during the same period (probably due to a change in species composition), while it has remained steady in the Ho'omalu zone (see previous figure).

NWHI Bottomfish inflation-adjusted revenue * per trip by zone, 1989-present.

	Ho'omalu Zone			Mau Zone		
Year	Inflation-adjusted Revenue ($1,000)	Trips	Inflation-adjusted per Trip ($)	Inflation-adjusted Revenue ($1,000)	Trips	Inflation-adjusted per Trip ($)
1989	$594	28	$21,214	$418	22	$19,000
1990	$545	25	$21,800	$791	55	$14,382
1991	$854	47	$18,170	$348	84	$4,143
1992	$1,138	37	$30,757	$232	55	$4,218
1993	$920	34	$27,059	$287	72	$3,986
1994	$929	41	$22,659	$501	99	$5,061
1995	$606	33	$18,364	$474	97	$4,887
1996	$576	26	$22,154	$417	81	$5,148
Average	$770	34	$22,772	$434	71	$7,603
Standard Deviation	$219	8	$4,251	$171	26	$5,760

Data: Data are compiled from NMFS shoreside market monitoring information. Inflation-adjusted values are to 1996 base.

Table 5. NWHI Ho'omalu zone bottomfish vessel, income statement (1994-96 average).

Income Statement – Ho'omalu zone bottomfish vessel, 1994-96			
Revenue			$147,350
Fixed Costs			$70,149
	Capital	$17,671	
	Annual Repair	$12,423	
	Vessel Insurance	$30,844	
	Administrative	$7,283	
	Other	$1,928	
Operating Costs			$116,779
	Fuel & Oil	$11,781	
	Ice	$2,785	
	Bait	$6,319	
	Handling	$14,700	
	Provisions	$8,568	
	Gear and Supplies	$10,174	
	Other (trip basis)	$11,352	
	Crew's income	$31,900	
	Captain's income	$19,200	
Total Cost			$186,928
Net Revenue			$-39,578

Interpretation: The average[3] Ho'omalu zone bottomfish vessel failed to cover its fixed costs through bottomfish operations in 1994-96. (Fixed costs are allocated entirely to Ho'omalu zone bottomfish operations.) These boats took only 6.8 trips into the Ho'omalu zone (annual average, 1994-96) totaling approximately 160 sea days. There was positive net revenue on operations (excluding fixed costs) (on average); presumably other fishing activities had to be employed to cover fixed costs.

Data: See notes following Part b.

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[3] Recalling that some vessels are undoubtedly performing better than the average on a per trip basis as well as taking more trips per year, and some are performing worse than the average.

Table 6. NWHI Ho'omalu zone bottomfish vessel economics, operating characteristics.

Operating characteristics – Ho'omalu zone bottomfish vessel, 1994-96		
Investment	$249,856	
Annual Trips	6.79	
Trip Days:	161	23.7
Fishing Days:	77	11.33
Catch per Day (Lbs): Total	610	
Bottomfish : Other	591	19
Total Catch (Whole lbs)	46,912	
Bottomfish : Other	45,476	
Price per Pound	$3.14	
Bottomfish : Other	$3.18	$1.80

Data: Cost-earnings data are compiled from Hamilton's (1994) cost-earnings report on the fishery. Operating data are compiled from Kawamoto's (1997) annual report on the fishery. Cost are adjusted for inflation.

Table 7. NWHI Mau zone bottomfish vessel, income statement (1994-96 average).

Income statement – Mau zone bottomfish vessel, 1994-96.			
Revenue			$44,132
Fixed Costs			$14,817
	Capital	$4,559	
	Annual Repair	$5,392	
	Vessel Insurance	$3,156	
	Administrative	$1,710	
	Other		
Operating Costs			$37,858
	Fuel & Oil	$4,712	
	Ice	$1,392	
	Bait	$1,928	
	Handling	$4,400	
	Provisions	$2,142	
	Gear and Supplies	$2,892	
	Other (trip basis)	$2,892	
	Crew's income	$7,200	
	Captain's income	$10,300	
Total Cost			$52,675
Net Revenue			$-8,543

Interpretation: The average[4] Mau zone bottomfish vessel failed to cover its fixed costs through bottomfish operations in 1994-96. (In this case, compared to the Ho'omalu zone boats, only a portion of fixed costs are allocated to Mau zone operations.) These boats took only 6.6 trips into the Mau zone (annual average, 1994-96) totaling approximately 62 sea days. There was positive net revenue on operations (excluding fixed costs) (on average). According to Hamilton (1994), main Hawaiian Islands bottomfishing, as well as other types of fishing operations, add at least 50 sea days per year to the balance sheet of a Mau zone vessel.

[4] Recalling that some vessels are undoubtedly performing better than the average on a per trip basis as well as taking more trips per year, and some are performing worse than the average.

Table 8. NWHI Mau zone bottomfish vessel economics, operating characteristics

Operating characteristics – Mau zone bottomfish vessel, 1994-96		
Investment	$149,935	
Annual Trips	6.59	
Trip Days:	62	9.47
Fishing Days:	36	5.47
Catch per Day (Lbs): Total	463	
Bottomfish : Other	319	144
Total Catch (Whole lbs)	16,684	
Bottomfish : Other	11,495	5,189
Price per Pound	$2.65	
Bottomfish : Other	$3.03	$1.80

Data: Cost-earnings data are compiled from Hamilton's (1994) cost-earnings report on the fishery. Operating data are compiled from Kawamoto's (1997) annual report on the fishery. Cost are adjusted for inflation.

Table 9: "Optimality" scenarios for NWHI bottomfish vessels, 1994-96.

	NWHI bottomfish "optimality" scenarios		
	NWHI Combined[5]	Mau zone	Ho'omalu zone
MSY Bottomfish Pounds	586,490	131,210	455,290
	Annual Bottomfish Catch (Pounds Landed) per Vessel		
1994-96 Average Operations & cpue	28,486	11,495	45,476
MSY cpue	30,559	12,360	48,758
Breakeven -- Total Costs	53,169	23,450	82,888
Breakeven - Operating Costs	21,913	9,605	35,105
Full-time Operations	59,591	40,142	79,039
	Number of vessels[6]		
1994-1996 actual	16.0	11.3	4.7
"Optimality" scenarios			
1994-96 Average	20	11	10
MSY cpue	19	10	9
Breakeven -- Total Costs	11	5	5
Breakeven - Operating Costs	26	13	12
Full-time Operations	9	3	5

Interpretation: This table presents current results using the methodology of the Limited Entry amendment for the Ho'omalu zone to determine the "optimal" number of vessels in each NWHI zone. There are any number of ways to define "Optimal". This table follows Pooley (1996) and defines three optimality criteria: MSY catch rates, breakeven on total costs, and full-time operations. (Results from 1994-96 average operations are also reported.)

The MSY catch rate scenario uses 1994-96 average operations and MSY cpue (catch rate), derived from a model by Kobayashi (1996). The breakeven on total costs figures are derived by increasing cpue to insure that vessels cover all fixed (annual) and operating (trip) costs, including crew share. The breakeven on operations figures are derived by decreasing cpue to require

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[5] Unweighted average of Mau and Ho'omalu zones.

[6] Integer values under *Optimality scenarios*

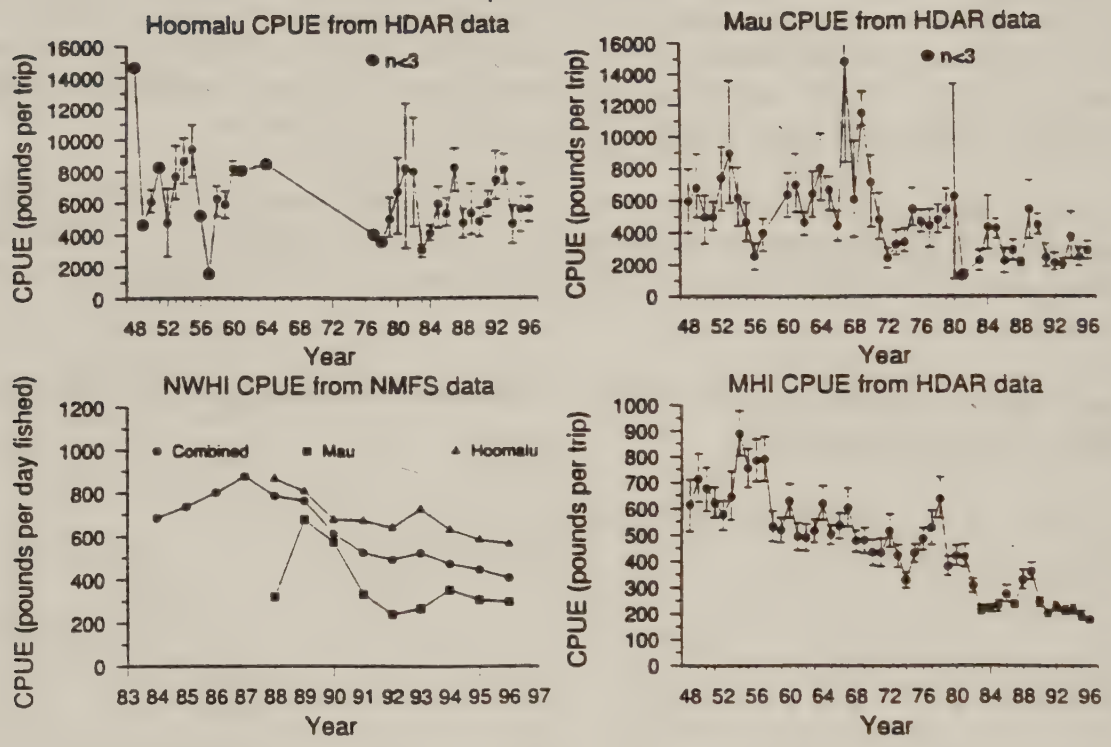
vessels only to cover their operating (trip) costs. The full-time operations scenario uses MSY cpue and increases number of trips to the maximum.

The Ho'omalu zone limited entry amendment used the criteria of breaking even economically on total costs (higher catch rates) or operating at full-scale (more trips per year at current catch rates). This generates the figure of 5-6 vessels as *optimal*. However, because of the reduced operating levels in 1994-96, current operations could sustain 10 vessels in the Ho'omalu zone (assuming no decrease in catch rates) which is similar to MSY catch rates.

The Mau zone is an open access area where the Ho'omalu zone criteria do not apply. Mau zone boats have historically been more mixed-use than the Ho'omalu zone vessels. The Council is currently working on a limited entry proposal for the Mau zone which may apply different optimality criteria.

Data: Data for this table is compiled from average income statements and MSY information obtained from Kobayashi (1996).

Figure 15a. CPUE for Hawaiian bottomfish



Interpretation: Decreases in MHI CPUE to about one-third of early CPUE values signify a yellow light condition for the fishery in this area. The increase in the late 1980s MHI CPUE was due primarily to a large increase in uku catches alone and may not indicate an increase in abundance of other species. And decreases in CPUE from the 1989-90 highs may be a return to normal rather than a decrease in normal abundance. The reasons for differing trends in CPUE values for the Hoomalu Zone with differing data sources are unclear.

Comments: There is a long-term decreasing trend in MHI CPUE, with current values approximately one-third that of initial. The 1996 MHI CPUE value is the lowest value on record. MHI trips are generally one day in length, so CPUE values presented here reflect catch per day as well as catch per trip.

The NMFS vessel interview NWHI CPUE for 1996 for the Mau Zone is similar to the 1995 value whereas the value has decreased slightly for the Hoomalu Zone. The 1996 HDAR CPUE values are similar to the 1995 values in both the Hoomalu and the Mau Zone. The HDAR CPUE is used for NWHI SPR calculations since it is a longer time series and may better estimate virgin

fishery catch rates. There are no correction factors for possible changes in trip duration or fleet composition.

Source: MHI CPUE is based on HDAR C-3 catch report data from commercial fishermen. Two NWHI CPUE's are presented, one based on the NMFS vessel interview program catch data, and one based on HDAR C-3 catch report data from commercial fishermen.

Calculation & Adjustment: MHI trips were screened to only include trips from the areas of Maui, Lanai, Molokai, and Penguin Banks that had at least 90% of the catch by weight in bottomfish. Additionally, some MHI small boats were excluded based on minimum annual landings criteria to correct for temporal changes in the fleet composition. The NMFS vessel interview data prior to 1988 does not allow separate Mau and Hoomalu CPUE calculations; therefore, the combined area NWHI CPUE is presented as well. The NWHI HDAR CPUE used data screened to only include trips where at least 90% of the catch by weight was bottomfish and at least 1000 pounds of bottomfish were caught. All catch data reported by the same licensee on consecutive days were collapsed to a trip summary, since 1) most other reports are apparent multi-day trip summaries, and 2) consecutive day reporting may be reflective of marketing rather than fishing activity. There was an apparent absence of Hoomalu Zone trips from the mid-1960s until the late-1970s. The 95% non-parametric confidence intervals for the HDAR CPUE's were calculated by bootstrapping.

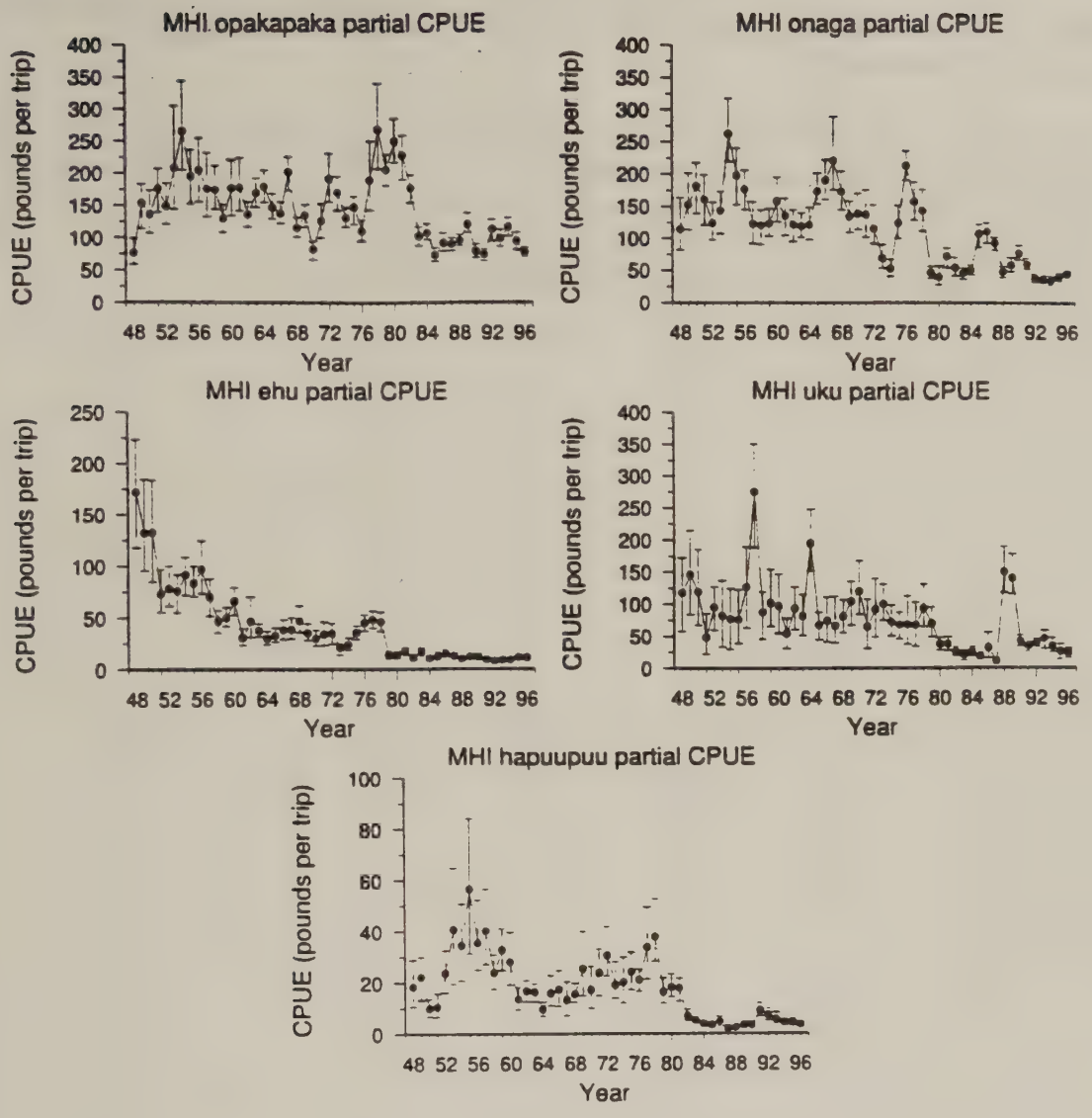
Figure 15a data summaries:

	Pounds/Trip		
Year	MHI	Mau	Hoomalu
1948	614	5968	14635
1949	713	6799	4614
1950	677	4966	6072
1951	621	4980	8228
1952	577	7407	4766
1953	645	8937	7627
1954	887	6158	8613
1955	755	4659	9336
1956	784	2523	5202
1957	789	3958	1535
1958	533	NA	6254
1959	519	NA	5897
1960	630	6379	8139
1961	496	6999	7978
1962	491	4641	NA
1963	518	6410	NA
1964	619	8028	8390
1965	503	6656	NA
1966	536	4413	NA
1967	602	14749	NA
1968	478	6055	NA
1969	480	11484	NA

1970	433	7111	NA
1971	433	4784	NA
1972	514	2386	NA
1973	421	3224	NA
1974	329	3367	NA
1975	430	5439	NA
1976	485	4653	NA
1977	527	4387	4000
1978	635	4753	3550
1979	380	5361	4951
1980	421	6210	6687
1981	416	1336	8167
1982	307	NA	7953
1983	214	2242	3025
1984	220	4308	4085
1985	230	4239	5909
1986	274	2206	5301
1987	237	2889	8187
1988	329	2136	4702
1989	361	5412	5328
1990	245	4454	4793
1991	202	2413	5928
1992	228	2092	7388
1993	213	1992	8040
1994	218	3748	4651
1995	193	2460	5544
1996	176	2876	5588

	NMFS NWHI CPUE (lb/day)		
Year	Mau	Hoomalu	Combined
1984	NA	NA	682
1985	NA	NA	736
1986	NA	NA	800
1987	NA	NA	877
1988	322	866	786
1989	677	808	763
1990	573	675	611
1991	333	671	525
1992	239	639	491
1993	267	723	523
1994	353	629	526
1995	306	582	442
1996	298	563	407

Figure 15b. Partial CPUE for MHI bottomfish


MHI opakapaka partial CPUE
MHI onaga partial CPUE
MHI ehu partial CPUE
MHI uku partial CPUE
MHI hapuupuu partial CPUE
CPUE (pounds per trip)
Year
48 52 56 60 64 68 72 76 80 84 88 92 96

Interpretation: Reduction of species-specific CPUE for species presented here to less than half of their early values would suggest a yellow light situation for these species, especially ehu and onaga. Caution must be used in this interpretation because factors such as targeting of effort to specific species is not taken into account (see next section for targeted effort).

Comments: All CPUE time series remain highly variable. There are apparent declines in most species when comparing several years of recent values with values earlier in the time series. The

decline is least apparent in opakapaka and most apparent in ehu. MHI trips are usually of one day duration.

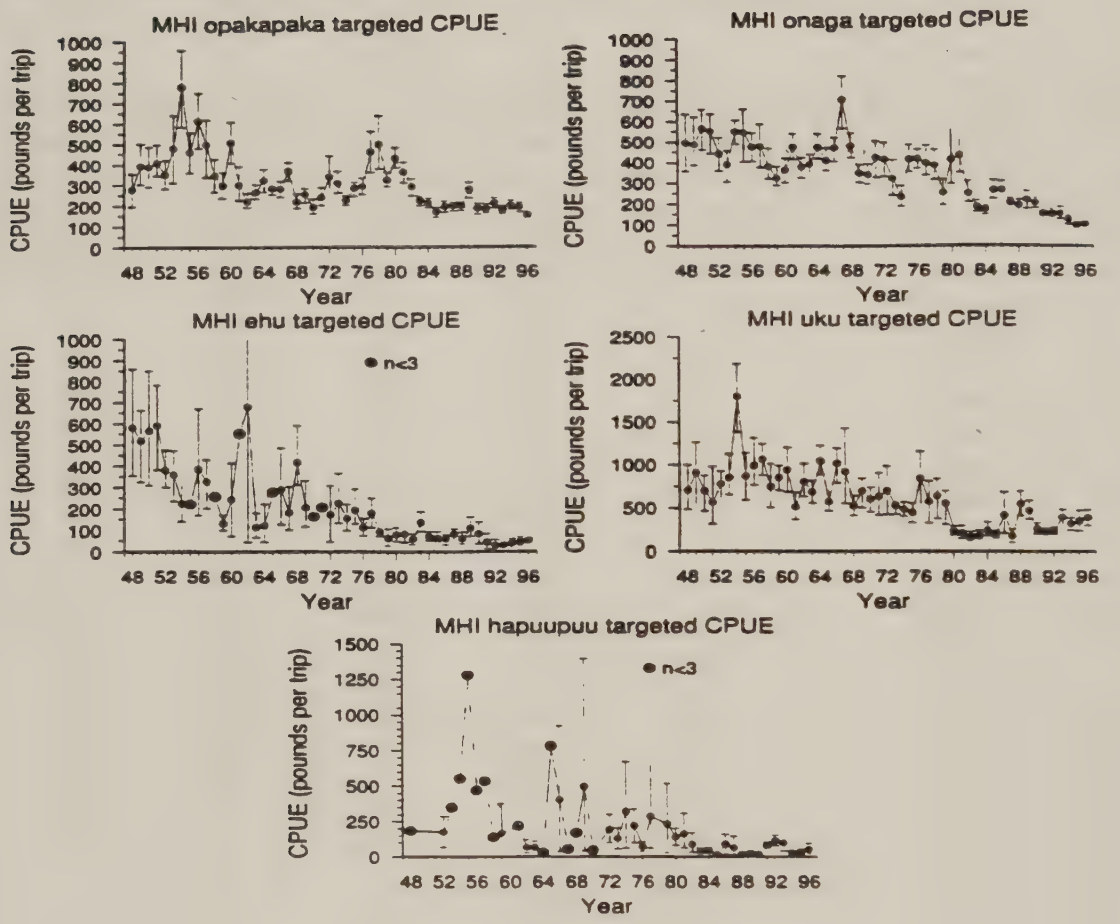
Source: The partial CPUE for the MHI is based on HDAR C-3 catch report data from commercial fishermen.

Calculation & Adjustment: The same subset of HDAR data as used in Fig. 15-A is used here, but the weight of each species is tabulated separately rather than in aggregate. The same denominator value used in Fig. 15-A is used here (# trips fished), i.e. summing these five partial CPUE's (and remaining BMUS CPUE's) will approximate the Fig. 15-A estimates. 95% non-parametric confidence intervals were calculated by bootstrapping.

Figure 15b data summary:

	MHI Partial CPUE (lb/trip)				
Year	OPA	ONA	EHU	UKU	HAP
1948	77	115	172	117	18
1949	153	153	132	146	22
1950	135	182	132	119	10
1951	176	161	73	48	11
1952	149	124	78	95	24
1953	208	144	76	82	41
1954	266	262	91	77	35
1955	195	198	83	76	56
1956	204	177	97	127	36
1957	176	124	70	275	40
1958	174	121	47	88	24
1959	130	124	50	103	33
1960	177	158	66	97	28
1961	178	136	31	54	13
1962	136	123	47	94	17
1963	169	120	38	82	16
1964	180	122	30	195	9
1965	148	174	33	67	16
1966	138	191	38	75	17
1967	203	222	39	66	13
1968	116	174	47	81	15
1969	135	135	35	104	25
1970	83	140	30	120	17
1971	127	138	34	65	24
1972	192	116	35	92	31
1973	171	70	21	101	19
1974	132	52	24	72	20
1975	149	124	36	68	24
1976	112	214	45	69	21
1977	191	158	49	67	34
1978	269	143	46	94	38
1979	207	47	13	70	16
1980	251	40	13	37	18
1981	229	72	18	37	18
1982	179	55	11	25	7
1983	104	46	17	20	5
1984	109	51	10	26	4
1985	74	107	12	18	3
1986	93	111	15	31	5
1987	91	93	13	10	2
1988	97	48	9	150	2
1989	122	59	12	140	3
1990	80	77	12	42	3
1991	75	60	9	34	9
1992	115	39	8	39	7
1993	100	37	9	46	6
1994	118	34	9	34	4
1995	96	40	11	26	5
1996	78	45	11	24	3

Figure 15c. Partial targeted CPUE for MHI bottomfish


MHI opakapaka targeted CPUE
MHI onaga targeted CPUE
MHI ehu targeted CPUE
MHI uku targeted CPUE
MHI hapuupuu targeted CPUE
CPUE (pounds per trip)
Year
48 52 56 60 64 68 72 76 80 84 88 92 96
n<3

Interpretation: Comparison of CPUE values of the last 10 years (1987-96) with the first 10 years available (1948-57) indicate that all four species for which sufficient data is available have CPUE values less than 50% of original values. Opakapaka CPUE values are at 42% of original, onaga at 35%, ehu at 14% and uku at 36%. These values represent a yellow light condition for these four species, with the ehu stocks being the most stressed.

Comments: As in Fig. 15-B, there are apparent declines when comparing several recent years with values earlier in the time series. The decline is least apparent in opakapaka. The level of screening done here severely reduces the size of the sample, and this may contribute to some of the observed variability.

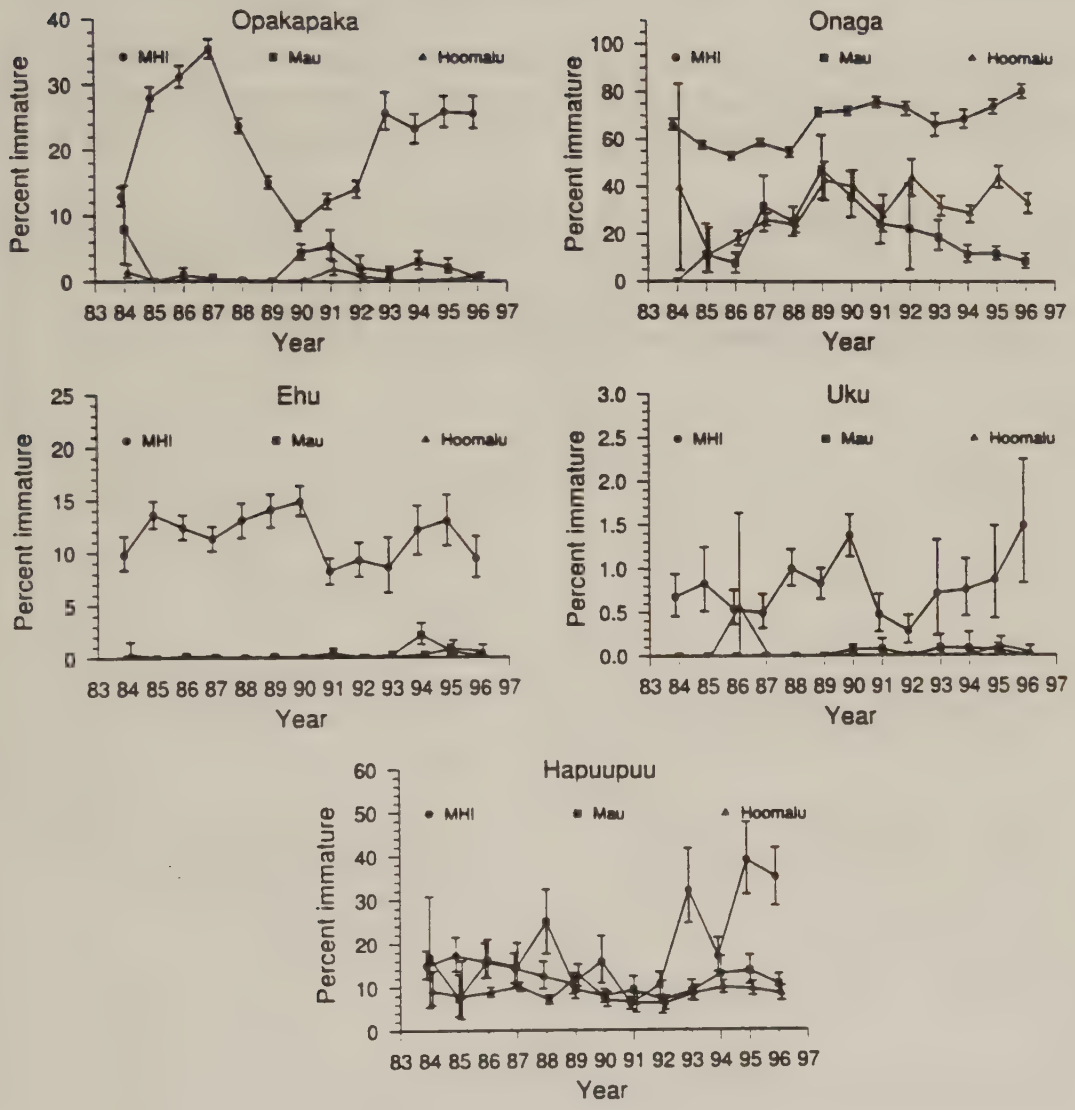
Source: The partial targeted MHI CPUE is based on HDAR C-3 catch report data from commercial fishermen.

Calculation & Adjustment: The data used in Fig. 15-A were further screened to only include trips where at least 50% of the total catch by weight is the target species. This can only be done for species that are targeted successfully; incidental catch species will not contribute significantly enough to the overall catch. 95% non-parametric confidence intervals were calculated by bootstrapping.

Figure 15c data summary:

	MHI Targeted CPUE (lb/Trip)			
Year	Opakapaka	Onaga	Ehu	Uku
1948	277	496	581	705
1949	391	488	517	913
1950	385	566	564	701
1951	406	554	589	567
1952	348	442	380	779
1953	476	390	358	850
1954	779	552	224	1796
1955	458	547	222	869
1956	613	473	384	988
1957	496	479	327	1061
1958	344	382	257	745
1959	293	325	130	852
1960	507	364	242	939
1961	297	476	550	514
1962	216	379	677	806
1963	263	394	111	683
1964	320	475	120	1046
1965	281	411	275	574
1966	280	472	288	1014
1967	366	706	180	919
1968	215	484	415	525
1969	254	353	203	696
1970	191	345	161	600
1971	241	428	205	634
1972	339	420	171	699
1973	309	324	226	531
1974	225	236	152	488
1975	284	419	194	448
1976	293	421	112	846
1977	462	400	178	573
1978	501	389	92	640
1979	323	255	61	552
1980	430	415	79	235
1981	364	433	83	212
1982	293	252	58	164
1983	225	186	135	179
1984	212	173	72	241
1985	168	266	63	193
1986	194	267	58	418
1987	199	206	82	175
1988	198	192	60	549
1989	278	221	109	468
1990	187	205	82	260
1991	183	153	45	224
1992	212	154	27	238
1993	176	155	28	393
1994	200	125	37	311
1995	191	100	45	343
1996	153	103	51	386

Figure 16. Percent immature in Hawaiian bottomfish catch



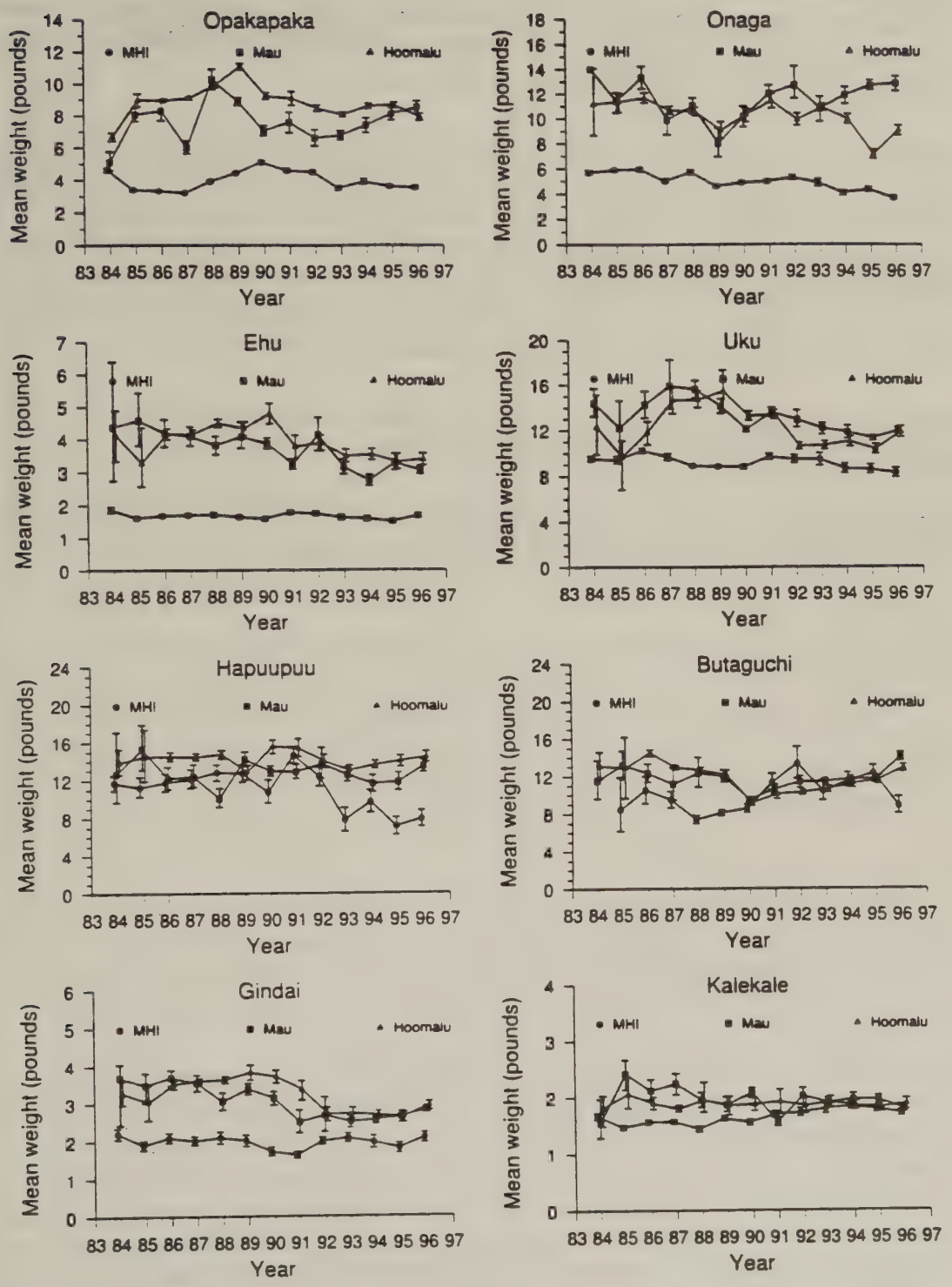
Interpretation: MHI onaga catch has the highest percentage of immature fish, and is the only one consistently over 50%, signifying a yellow light condition. The NWHI stocks are all in the healthy range for percentage of immature fish in the catch.

Comments: MHI catch is comprised of more immature fish than NWHI catch. In all areas onaga values are among the highest. Percent immature for uku are the lowest (i.e. healthiest) values in all zones. Among the other species, MHI opakapaka experienced periods of relatively high values (peaking in the years 1985-87). MHI Hapuupuu declined from a significant increase in 1993 back to its normal range in 1994 then rose sharply again in 1995 and 1996.

Source: Fish size data is derived from auction lot statistics obtained at the Honolulu UFA auction by HDAR, NMFS and WPRFMC personnel. Size at maturity from Everson (1984), Everson (1990 unpub. rep.), Everson et al. (1989), Kikkawa (1984), Sudekum et al. (1991).

Calculation & Adjustment: The percent immature is calculated in terms of weight. The size distribution of sold fish is assumed to be representative of all fish caught. Maturity was assumed to be "knife-edge", and all fish in the same sales lot were assumed to be of equal size. 95% non-parametric confidence intervals were calculated by bootstrapping.

Figure 17. Mean weight of Hawaiian bottomfish



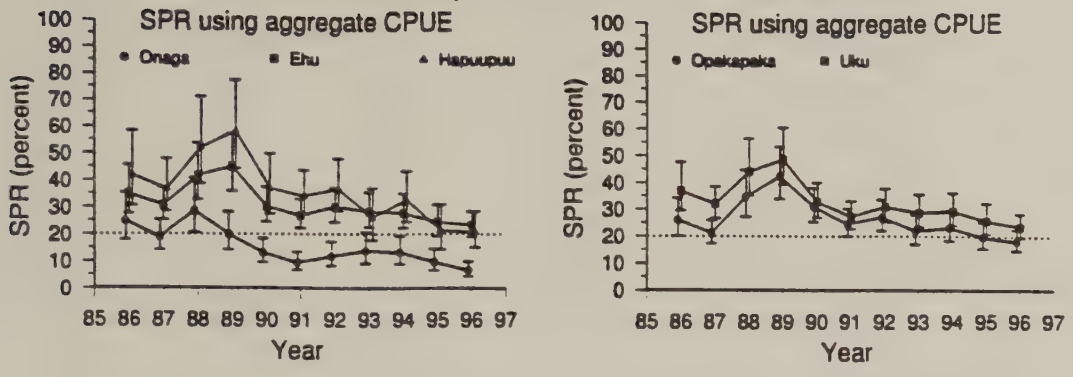
Interpretation: MHI mean weights are considerable lower than NWHI weights indicating considerable stress on these stocks. No noticeable trends can be seen in NWHI mean weights, indicating relative health of these stocks. Low mean weights recorded for hapuupuu in 1993, 1995 and 1996 may be artifacts of the small number of fish upon which this estimate is based or may reflect actual drops in weight. The 1996 repeat of the 1993 and 1995 low mean weight values supports the later, but a longer time series is required.

Comments: Mean weights of fish in the NWHI catch are generally larger than those in the MHI catch. With the notable exception of the Hoomalu onaga mean weight, most 1996 values are similar to past values. The 1995 Hoomalu onaga value shows a sharp drop from the 1994 value, but has recovered to a large extent in 1996. MHI values have been remarkably stable for most species over the time series available, with continuously decreasing sizes found only in the MHI onaga and this decline is very gradual. MHI hapuupuu mean weight has fluctuated to a greater extent over the last four years with very low mean weights recorded for 1993, 1995 and 1996.

Source: Fish size data is derived from auction lot statistics obtained at the Honolulu UFA auction by HDAR, NMFS, and WPRFMC personnel.

Calculation & Adjustment: The size distribution of sold fish is assumed to be representative of all fish caught. All fish in the same sales lot were assumed to be of equal size.

Figure 18a. Spawning potential ratio (SPR) for MHI bottomfish



Interpretation: The peak SPR values observed in 1988-1989 for all species were largely a response to increases in aggregate CPUE due to increased uku landings. Onaga and opakapaka SPR values indicate a red light situation for these species and the hapuupuu value is just above. Values for other MHI species have not been below the 20% threshold, but have occasionally been close and the lower confidence limits have dipped below this level on occasion.

Comments: Current SPR estimates for only two of the five species are above the twenty percent critical level used as an indicator of recruitment overfishing. Onaga remains below 0.20 for the seventh year in a row. Hapuupuu and opakapaka SPR values dropped to 0.21 and 0.18 respectively, entering the critical zone. The sharp drop in hapuupuu SPR in 1995 is due to a combination of factors including a lower aggregate CPUE in 1995 and a marked rise in the percentage of immature individuals in the catch determined by a drop in mean weight. The 1996 hapuupuu values are similar to the 1995 values for these measures.

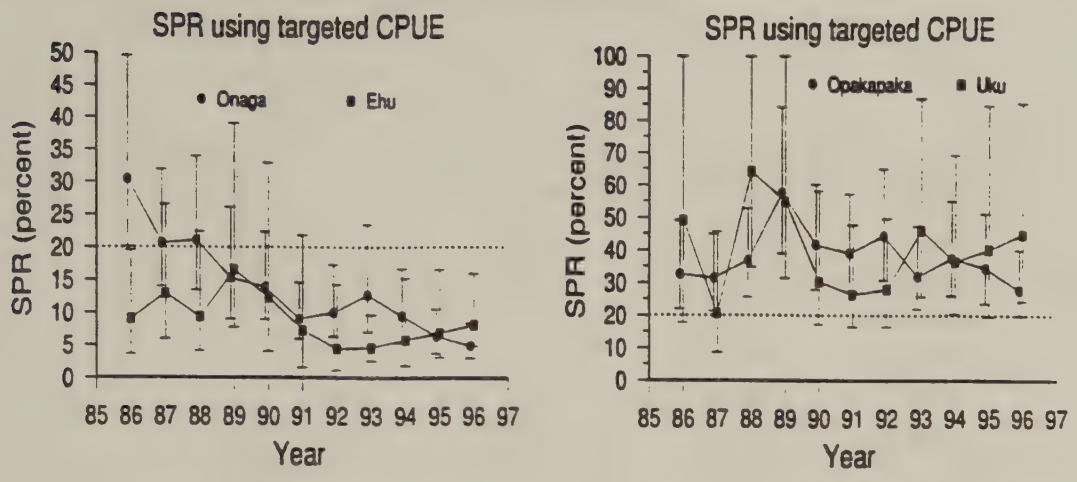
Source: SPR estimated from the Honolulu UFA auction size frequency data collected by HDAR, NMFS, and WPRFMC personnel; CPUE estimates from C-3 form data reported to HDAR by commercial fishermen. Additional information for opakapaka obtained from size frequency data of fish caught from the R/V Townsend Cromwell.

Calculation & Adjustment: Calculations use similar methodology as presented in Somerton and Kobayashi (1990) for dynamic SPR. Virgin CPUE estimate is 1948-1952 mean; current CPUE estimate is a single year estimate. CPUE is of aggregate bottomfish from the areas of Maui, Lanai, Molokai, and Penguin Banks (see Fig. 15-A for more details). Virgin catch size composition is estimated from the 1986-1988 NWHI catch data, and current catch size composition is estimated from single year MHI catch data. All SPR values changed slightly from previous year's reports due to improvements in the calculations. The 90.25% non-parametric confidence intervals were constructed based on "best" and "worst" case bounds of SPR components (CPUE and percent immature).

Figure 18 data summary:

	SPR (%)				
Year	**Ehu**	**Hapuupuu**	**Onaga**	**Opakapaka**	**Uku**
1986	35	42	25	26	37
1987	31	37	19	21	32
1988	42	52	29	35	44
1989	45	58	20	42	48
1990	30	37	13	31	33
1991	27	34	9	24	27
1992	30	37	12	27	31
1993	28	26	14	22	29
1994	28	33	13	23	29
1995	24	21	10	20	26
1996	23	21	7	18	24

Figure 18b. Spawning potential ratio (SPR) for MHI bottomfish using targeted CPUE



Interpretation: We feel that SPR values obtained here may better represent the condition of the stocks in regards to recruitment overfishing than those found in the previous section. Ehu and onaga stocks are clearly recruitment overfished, with ehu below the 0.20 level for the duration of our data and onaga on a continuing downward trend with values below 0.20 for the last 8 years. Contrary to the results obtained in the previous section, opakapaka SPR levels have remained above the 0.20 mark for all years sampled and does not indicate a critical recruitment overfished condition.

Comments: This is the second year that SPR values have been calculated using targeted CPUE values. These values are available for only four of the BMUS species present in the MHI. As expected onaga and ehu values are below the 0.20 critical level and have been for many years. SPR values for each of these two species are lower using targeted CPUE than they are using aggregate CPUE. Opakapaka SPR values are higher using targeted CPUE compared to using aggregate CPUE. For opakapaka the 1996 SPR value obtained using aggregate CPUE indicates a critical situation (at SPR = 0.18) whereas that using targeted CPUE indicates a non-critical level. Uku SPR values are non-critical using either CPUE method.

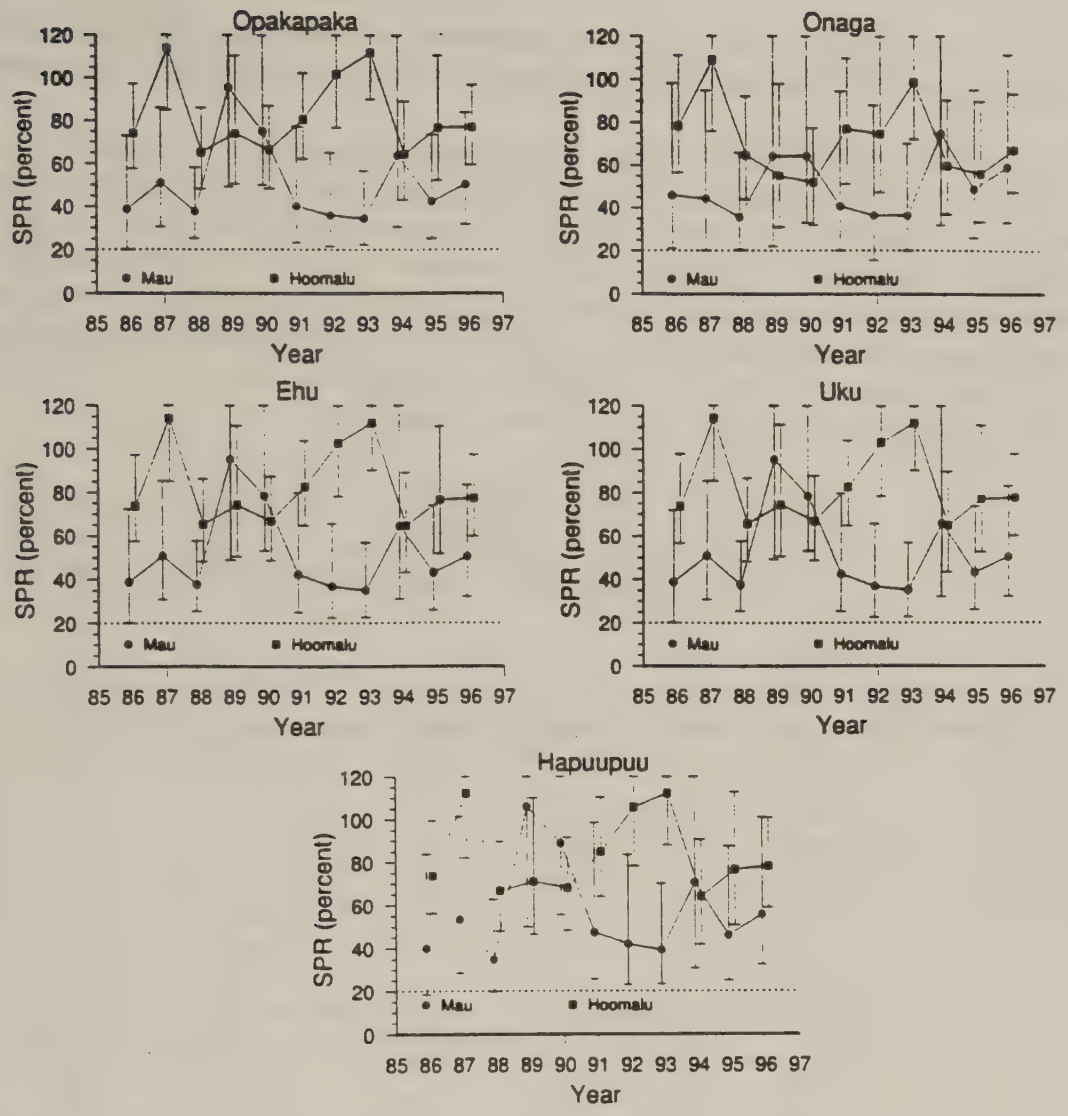
Source: SPR estimated from the Honolulu UFA auction size frequency data collected by HDAR, NMFS, and WPRFMC personnel; CPUE estimates from C-3 form data reported to HDAR by commercial fishermen and screened for trips targeting particular species. Additional information for opakapaka obtained from size frequency data of fish caught from the R/V Townsend Cromwell.

Calculation & Adjustment: Calculations are conducted as in the previous section with targeted CPUE substituting for aggregate CPUE.

Figure 18b data summary:

	SPR (%)			
Year	Opakapaka	Onaga	Ehu	Uku
1986	32.71	30.37	8.99	49.11
1987	31.42	20.6	12.91	20.57
1988	36.88	21.03	9.3	64.24
1989	57.6	15.31	54.87	54.87
1990	41.73	13.86	12.32	30.29
1991	39.18	8.99	7.23	26.37
1992	44.41	9.95	4.37	28.01
1993	31.93	12.65	4.56	46.13
1994	37.48	9.49	5.76	36.51
1995	34.59	6.34	6.85	40.17
1996	27.85	4.84	8.09	44.91

Figure 19. Spawning potential ratio (SPR) for NWHI bottomfish



Interpretation: The correlation of SPR values among species is due the high dependence of SPR on the CPUE component, given that the maturity component is nearly negligible. All species utilize the same aggregate bottomfish CPUE component. The maturity component is small relative to MHI SPR calculations because 1) the NWHI catch is primarily mature fish, and 2) the current catch size composition is relatively unchanged from the best estimate of the virgin catch size composition.

Comments: Current SPR estimates for all five species in both zones are above the 0.20 critical level used as an indicator of recruitment overfishing though lower confidence limits often are

near or slightly below this level. Mau Zone SPR estimates tend to be lower than Hoomalu Zone SPR estimates for most species, and onaga SPR estimates tend to be slightly lower than those for most other species.

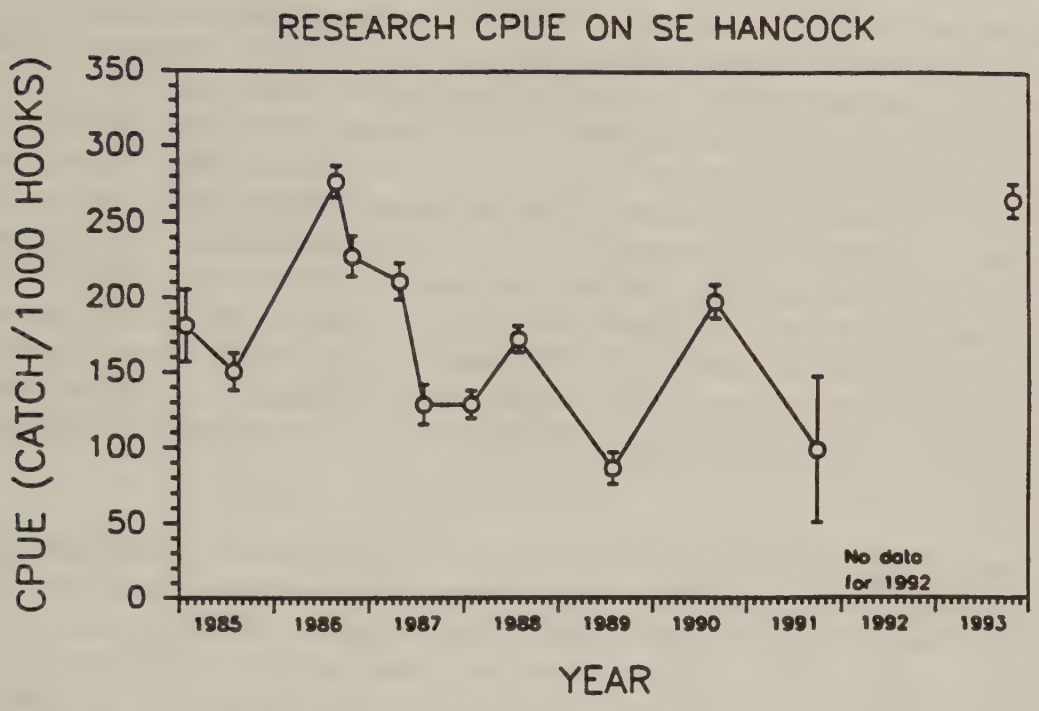
Source: SPR estimated from Honolulu auction size frequency data collected by NMFS personnel, and CPUE estimates from C-3 form data reported to HDAR by commercial fishermen.

Calculation & Adjustment: Calculations use same methodology as presented in Somerton and Kobayashi (1990) for dynamic SPR. Virgin CPUE estimate is 1948-52 mean; current CPUE estimate is a single year estimate. CPUE is of aggregate bottomfish calculated separately for Mau and Hoomalu Zones. Virgin catch size composition is estimated from the 1986-88 NWHI catch data, and current catch size composition is estimated from single year catch data. All SPR values changed slightly from previous year's reports due to improvements in the calculations. 90.25% non-parametric confidence intervals were constructed based on "best" and "worst" case bounds of SPR components (CPUE and percent immature).

SPR (%)

Year	Ehu	Hapuupuu	Onaga	Opakapaka	Uku
Mau Zone					
1986	39	40	46	39	39
1987	51	53	44	51	51
1988	38	35	36	38	38
1989	95	106	64	96	95
1990	78	89	64	75	78
1991	42	47	41	40	42
1992	37	42	36	36	37
1993	35	39	36	35	35
1994	65	71	75	64	66
1995	43	46	49	43	43
1996	51	56	59	51	51
Hoomalu Zone					
1986	74	74	78	74	74
1987	114	112	109	114	114
1988	66	67	65	66	66
1989	74	71	55	74	74
1990	67	68	52	67	67
1991	83	85	77	81	83
1992	103	106	75	102	103
1993	112	112	99	112	112
1994	65	64	60	65	65
1995	77	77	56	77	77
1996	77	78	67	77	78

Figure 20



Interpretation: The fluctuations in CPUE shown in Figure H-20 are apparently the result of episodic recruitment followed by high natural mortality. These peaks in CPUE correspond to years (1986 and 1990) where an appreciable proportion (at least one-third) of the armorhead population consisted of fat individuals (fatness index $\geq$0.26) considered new recruits to the seamount population. Fatness index is defined as body depth divided by fork length. Subsequent to recruitment individuals cease somatic growth and over the course of 3-4 years, survivors decline in fatness index and weight. Without subsequent recruitment to the population in seceding years, the armorhead population as a whole would decline both in numbers (natural mortality) and in biomass (declining fatness index). The high 1993 CPUE is unusual, however, since fat individuals (new recruits) account for <15% of the 1993 population while leaner individuals (<0.23 in fatness index) form the bulk of the population. These results apparently indicate that the 1993 population is primarily derived from recruitment which occurred either in

late 1991 or during 1992. Previous work indicates that little if any annual recruitment to SE Hancock Seamount occurs after the summer months (Humphreys et al. 1993; Fishery Bulletin, U.S. 91:455-463). Since the 1991 stock assessment survey coincided with the end of the summer season, the increase in CPUE at SE Hancock for 1993 is most likely due to good recruitment during 1992. The sharp increase in the 1992 CPUE among seamounts outside the U.S. EEZ implies that a high recruitment occurred (across all seamounts) in 1992.

Data Source: Figure H-20 presents CPUE based on research longline catches at SE Hancock Seamount by NMFS, Honolulu personnel aboard NOAA ship R/V Townsend Cromwell. Vertical bars represent the 95% confidence intervals about the mean CPUE. The CPUE derived from the September 1991 stock assessment survey was computed using data from only the first 5 bottom longline sets as opposed to the standard 40 sets used on all other research surveys. The armorhead population at SE Hancock Seamount was not assessed in 1992 and post-1993 and therefore no current CPUE estimates are available. The last stock assessment survey for armorhead at SE Hancock Seamount was conducted in October 1993. Future NMFS armorhead stock assessment cruises to SE Hancock Seamount are unlikely. Henceforth, annual armorhead SPR values for Colahan Seamount (located outside the U.S. EEZ) will be provided to serve as a relative indicator of armorhead stock levels at the Hancock Seamounts (see explanation in Calculations & Adjustments subsection of ARMORHEAD SPAWNING POTENTIAL RATIO section).

Calculations & Adjustments: Fishing gear and sampling methods utilized during armorhead stock assessment surveys at SE Hancock Seamount are described in Somerton and Kikkawa (1992; Fishery Bulletin, U.S. 90:756-769). The seamount is divided into quadrants and effort is portioned equally among quadrants. Within each quadrant, effort is conducted over four depth strata (<265 meters (m), 265-300 m, 301-400 m, and 401-500 m). CPUE is calculated as a depth stratified average. Based on gear comparison studies of fishing droppers with and without hook timers conducted on the August 1990 survey, new coefficients accounting for the negative effects of hook timers were computed and applied to the catches obtained on all SE Hancock research surveys since 1985.

Tabulated Values:

MONTH/YEAR	ARMORHEAD CPUE
JAN 1985	181.28
JUN 1985	150.51
AUG 1986	276.80
OCT 1986	228.03
APR 1987	210.98
AUG 1987	128.73
JAN 1988	128.77
JUL 1988	172.14
JUL 1989	86.69
AUG 1990	197.08
SEP 1991	98.97
1992	(unknown)
OCT 1993	264.85
1994	(unknown)
1995	(unknown)
1996	(unknown)

Figure 21. Armorhead Spawning Potential Ratio

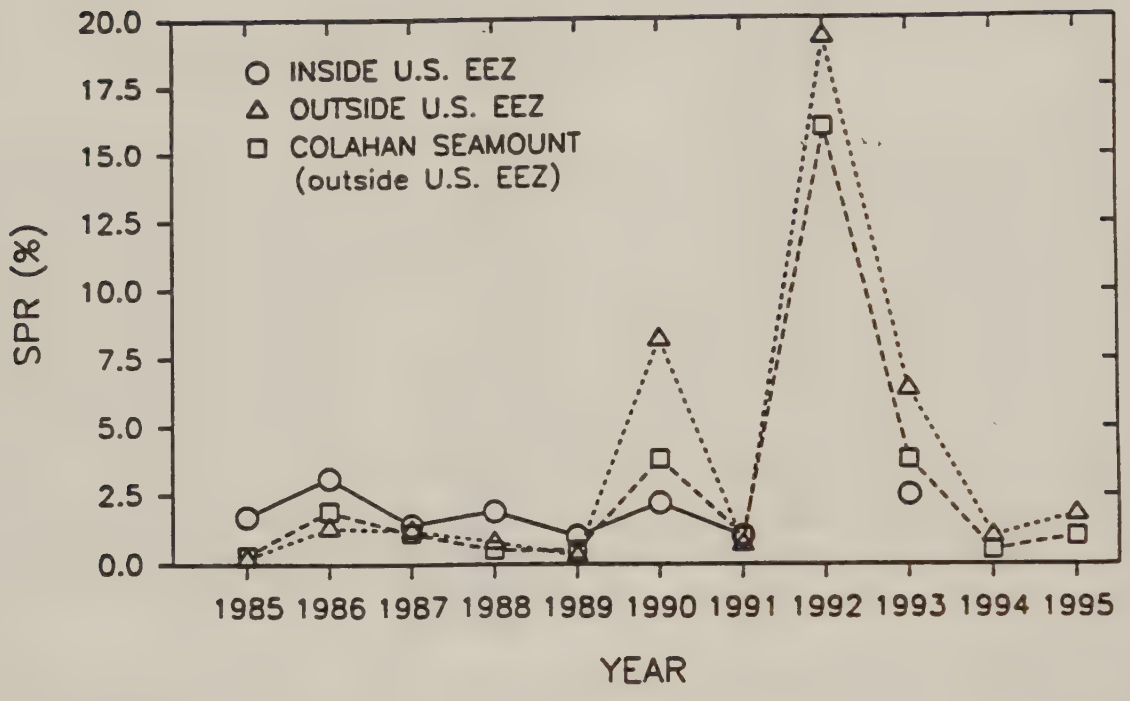
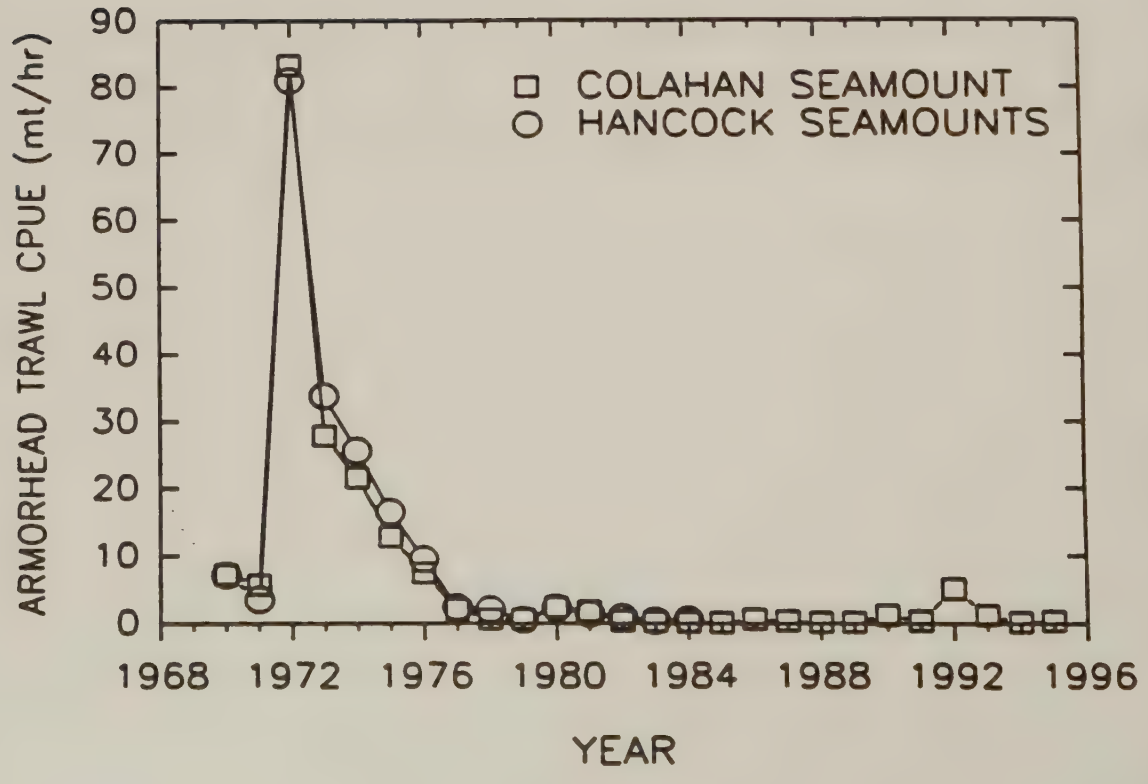


Figure 22.



Interpretation: SPR within the region outside of the U.S. EEZ, which historically (Japan trawl fleet during the 1969-1981 period) contributed 91% of the total catch of armorhead, is 1.8%; based on the most current (1995) available catch and effort statistics from the Japan North Pacific trawl fishery. This indicates a continued depression in stock levels since the dramatic increase of SPR levels outside the U.S. EEZ in 1992 and the equally dramatic decline since then. This continued decline outside the U.S. EEZ is interpreted to be a result of sustained intensive effort on the high 1992 recruitment stock coupled with little subsequent recruitment during 1993-1995 to compensate for losses do to fishing and natural mortality. Based on previous trends, catch levels are expected to remain low in 1996 unless offset by a large recruitment event.

Based on current estimates of a 2-2.5 year pelagic phase prior to seamount recruitment, the 1992 recruitment would have originated from the 1989-1990 winter spawning season. If this is correct, then the large 1992 recruitment originated from a parental stock which in 1989 had the lowest SPR values both inside and outside the U.S. EEZ (see table next page). This would appear to support the notion that dramatic increases in armorhead abundance across the seamounts are episodic and the product of environmental factors rather than simply a stock-recruitment relationship.

During February-March 1997, an oceanographic and larval armorhead survey over the seamounts outside the U.S. EEZ was conducted onboard the R/V Kaiyo Maru by the National Research Institute of Far Seas Fisheries Laboratory in Shimizu, Japan. Initial plans were to include research trawl hauls over Colahan Seamount, however, the ship was no longer equipped to conduct bottom trawl operations. Armorhead larvae were collected from surface waters around all seamounts except for Koko Seamount.

Data Source: SPR values for seamounts outside the U.S. EEZ are based on reported catch and effort data from the Japanese trawler fleet and values for seamounts within the U.S. EEZ (Hancock Seamounts) are based on research longline CPUE in addition to the trawl CPUE. However, with the cessation of research longline cruises to the Hancock Seamounts, SPR values for Colahan Seamount (comparable in size and located closest to the Hancocks among seamounts outside the U.S. EEZ) are being provided now and in the future as an indicator of stock levels at the Hancock Seamounts. SPR values for Colahan Seamount are also based on reported catch and effort data at that seamount by the Japanese trawler fleet.

Calculations & Adjustments: SPR values outside the U.S. EEZ are computed as the current year CPUE divided by the average CPUE during the first three years of the fishery (1970-1972). SPR values inside the U.S. EEZ are computed as the estimated biomass on SE Hancock Seamount divided by the 1970-1972 average biomass. Biomasses are estimated using procedures described in Somerton and Kikkawa (1992). The SPR values for Colahan Seamount are computed as the current year CPUE divided by the average CPUE during the first three years of the fishery (1970-1972) at Colahan Seamount (Figure H-20). Fishery catch and effort data by seamount by month for seamounts outside the U.S. EEZ have been provided annually since 1980 by colleagues at the National Research Institute for Far Seas Fisheries in Shimizu, Japan.

The decision to use SPR values for Colahan Seamount (instead of the overall outside U.S. EEZ values) as an indicator of armorhead stock conditions inside the U.S. EEZ (i.e., Hancock Seamounts) is based on the greater similarities between these seamounts. Aside from Colahan Seamount, the seamounts fished for armorhead outside the U.S. EEZ are Milwaukee Seamounts and Koko Seamount. These latter seamounts have summit areas of 67 and 564 nm^2 and average summit depths of 190 and 170 fm, respectively, while Colahan and the Hancock Seamounts have much smaller summit areas (about 1.4 nm^2) and shallower summit depths (141-150 fm). Fishing effort by the Japan trawl fleet has historically been different at these two types of seamounts. Koko and Milwaukee Seamounts have always received the majority (about two-thirds) of the annual total trawling effort and were typically fished intensively over a sustained period of time. However, the fishing effort at Colahan and the Hancock Seamounts was applied in pulses since catch levels could not be sustained for more than several days without a "cooling off" period. These similarities plus the historical close coincidence between Colahan and Hancock Seamounts in temporal profiles of armorhead CPUE from the Japan trawl fleet (Figure H-21) indicate that SPR values for Colahan Seamount should provide the best future indicator of armorhead stock levels at the Hancock Seamounts.

Tabulated Values:

	Armorhead SPR (%)		
Year	Inside US EEZ	Colahan	Outside US EEZ
1985	1.7	0.3	0.2
1986	3.1	1.9	1.3
1987	1.4	1.1	1.2
1988	1.9	0.5	0.8
1989	1	0.5	0.3
1990	2.2	3.8	8.2
1991	1	1	0.7
1992	NA	16	19.3
1993	2.5	3.8	6.4
1994	NA	0.5	1
1995	NA	1	1.8
1996	NA	NA	NA

Management Issues: The current 6-year fishing moratorium at the Hancock Seamounts is due to expire after August 31, 1998. Based on the low SPR values through 1995 both at Colahan Seamount and at all seamounts collectively outside the U.S. EEZ, it is inferred that the status of the Hancock Seamounts armorhead stock is similarly depressed and well under the 20% SPR level. This necessitates a continued protection of the resource within the U.S. EEZ and we recommend that the moratorium be extended for at least another 6 years. This recommendation along with a review and current status of the armorhead fishery was presented at meetings before the Scientific and Statistical Committee, Bottomfish Standing Committee, and 92nd Council Meeting in April 1997.

Appendix 4

Northern Mariana Islands

CONTENTS

page

1. Introduction 4.2
2. Summary 4.3
3. Recommendations 4.4
4. List of Tables 4.5
5. List of Figures 4.5

Introduction

The Northern Mariana Islands (NMI) bottomfish fishery occurs primarily around the islands and banks from Rota to Zealandia Bank north of Sarigan. However, this discussion will be limited to the catches landed on Saipan which is by far the largest market. The fishery will be characterized by data collected through the Commercial Purchase Data Base which indirectly records actual landings by recording all local fish sales to commercial establishments. This data collection system is dependent upon first-level purchasers of local fresh fish to accurately record all fish purchases by species categories on specially designed invoices. Division of Fish and Wildlife (DFW) staff routinely collect and distribute invoice books to more than 60 participating local fish purchasers; which include practically all fish markets, stores, restaurants, hotels, government agencies and roadside vendors (fish-mobiles). Although this data collection system has been in operation since the mid-1970s, only data collected since 1983 are considered accurate enough to be comparable for most aspects of the fishery.

The NMI's bottomfish fishery still consists primarily of small-scale local boats engaged in commercial and subsistence fishing but in recent years larger vessels (35'-50') have entered the fishery. The bottomfish fishery is broken down into two categories; deep (>500 ft) and shallow(100-500ft) water fishing. The deep water fishery is primarily commercial, targeting snappers and groupers. The snappers targeted include the Eteline and Pristipomoides complexes, whereas the Eight-banded grouper (*Epinephelus octofasciatus*) is exclusively targeted. The shallow water fishery, which targets the Red-gilled emperor, is mostly commercial but also includes subsistence fishers. Hand lines, home fabricated hand reels and electric reels are the common gear used for small-scale fishing operations, whereas electric reels and hydraulics are the common gear used for the larger operations in this fishery. Historically, some trips have lasted for more than a day, but currently, however, effort is defined and calculated on a daily trip basis. Fishing trips are generally restricted to daylight hours, with all vessels returning before or soon after sunset. In terms of participation the bottomfish fleet consists primarily of vessels less than 24 feet in length which are usually limited to a 20-mile radius from Saipan. The larger commercial vessels that are able to fish extended trips, and which focus their effort from Esmeralda Bank to Zealandia Bank, have landed the majority of the bottomfish reported through the purchase receipt form. In 1996, two commercial ventures continued operation in the Northern Islands of the NMI, resulting in the landing of a large volume of onaga (*Etelis coruscans*) and Eight-banded grouper. The company which commenced fishing in the Northern Islands last year has continued operations, though using only one of its two 50' Japanese built vessels.

Bottom fishing requires more technical skill than pelagic trolling, plus knowledge of the location of specific bathymetric features. Presently, Bottom fishing can still be described as "hit or miss" for most of the smaller size (14-25 ft.) vessels. Without fathometers and even nautical charts, the majority of fisherman utilizing smaller vessels often rely on land features for guidance to a fishing area. This type of fishing is inefficient and usually results in a lower CPUE in comparison with pelagic trolling. Larger sized (25 ft. and above) vessels typically utilize Global Positioning System (G.P.S.), fathometers and electric reels, resulting in a far more efficient operation.

Summary

Through documentation of increased landings, it is apparent that Bottom fishing activity in the NMI has steadily increased from its decline five years ago. The increased "growth" in the fishery is evidenced by the 84% increase over 1995 landings and the 160% increase over 1993 landings. Domestic US, joint-venture, and foreign vessels are still inquiring about full-time Bottom fishing throughout much of the NMI. The impact to the commercial market is still unclear despite a fish market assessment study that was conducted in 1994, but only recently completed in late 1996. This study did not correspond with the significant increase in the Northern Islands bottomfish harvest.

The number of commercial Bottom fishing ventures, and subsequently trips, operating in the Northern Islands increased last year. These trips have been sampled on a intermittent basis. Summaries of these data are included as an attachment to this module. These data will be further analyzed and compiled into a format more accessible to the general fisheries community.

Revenues and prices will probably continue to increase with renewed fishing interest, larger financial investment, and increased utilization of modern electronics and equipment. Deep water snappers still command the best prices. Fishermen utilizing larger vessels will have greater access to these deep water resources, especially in the Northern Islands of the NMI. Subsequently, the market demand should continue to increase as the supplies of these fish increase with consistent quality. This industry could continue to grow with potential support by a training program in bottomfishing that addresses the following; proper fish handling, use of fathometers, nautical charts, modern electronic equipment such as GPS, fish finders, electric reels, plus anchoring techniques and marketing.

With the potential expansion of biological data collection from the bottomfish fishery, as well as DFW fishing surveys, an assessment should be completed for the bottomfish stocks surrounding Saipan. After identifying the extent of resource utilization, additional data collecting could be used to help determine comprehensive management strategies. Continued sampling of vessels fishing bottomfish plus actual fishing by DFW in the Northern Islands of the NMI would provide more accurate estimates of CPUE.

Recommendations

1) Establish an ongoing bottomfish monitoring program to provide needed data for the commercial bottomfish fishery, contingent upon the Council identifying a funds to implement and maintian the program, with assiatance from NMFS/WPacFIN.

2) Establish baseline (virgin stock) parameters (CPUE, percent immature) for the Guam/Northern Marianas deep-water bottomfish complex (e.g., survey on grouper, snapper) utilizing data collected during Resource Assessment Investigation of the Marianas Archipelago (RAIOMA) cruises (1981-1984), the current fishing in the Northern Islands and sampling aboard DFW research vessel to help calculate SPR, with assistance from NMFS.

3) Establish baseline (virgin stock) parameters (CPUE, percent immature) for the Guam/Northern Marianas shallow-water bottomfish complex (e.g.,red-gilled emperor) by

sampling program aboard DFW research vessel to help calculate SPR, with assistance from NMFS.

4) With assitance from NMFS/WPacFIN, software should be developed and implemented to separate fishery statistics for the main islands fishery and from the Norhtern Islands fishery with separate descriptions and statistics reported in the anual report module.

Tables

page

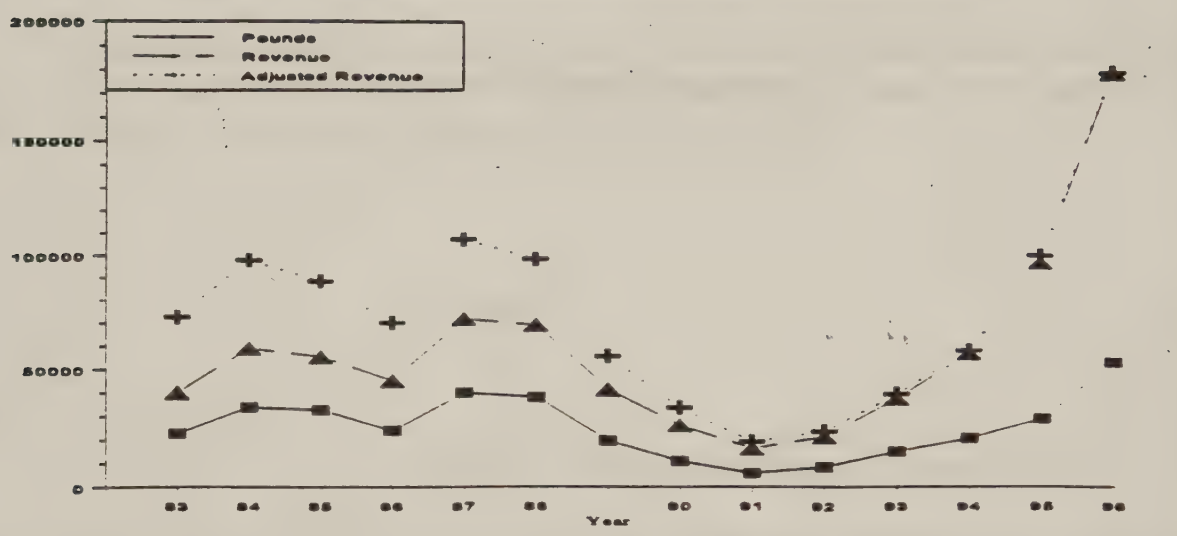
1. NMI 1994 commercial landings of bottomfish species 4-7

Figures

page

1. NMI commercial bottomfish landings and revenue 4-6
2. Number of NMI fishermen (boats) making bottomfish landings 4-8
3. Number of NMI bottomfish trips 4-9
4. NMI average price of bottomfish 4-10
5. NMI average inflation adjusted revenue per trip landing bottomfish 4-11
6. NMI bottomfish catch in average pounds per trip 4-13

Figure 1. NMI commercial bottomfish landings and revenue.



Interpretation: Landings, revenues and adjusted revenues for 1996 have increased significantly over 1995. The increases are attributed to the increase in Bottom fishing effort (Fig. 3), particularly the two full-time commercial operations active in the Northern Islands in 1996.

Calculation: Landings in pounds are from a simple data base summation of reported purchases of all bottomfish species combined. Revenue in dollars is from the same type of data base summation of the value field. The inflation adjustment is made using the Consumer Price Index (CPI) and establishing the 1996 CPI figure as the basis by which calculations of previous years' prices are made.

Year	Pounds	Unadjusted Revenue	Inflation-Adjusted Revenue
1983	22,683	40,003	72,405
1984	33,924	59,005	97,948
1985	32,780	55,396	88,634
1986	23,929	45,079	70,323
1987	39,772	71,868	107,083
1988	37,850	69,052	98,054
1989	19,550	41,379	55,448
1990	10,903	26,323	33,693
1991	5,693	16,118	19,019
1992	8,148	21,032	23,135
1993	14,769	37,310	39,176
1994	20,363	56,405	57,533
1995	28,744	96,100	98,983
1996	**52,967**	**176,707**	**176,707**
Average	23,876	61,229	70,883
Standard Deviation	13,408	40,371	41,798

Table 1. NMI 1996 commercial landings of bottomfish species

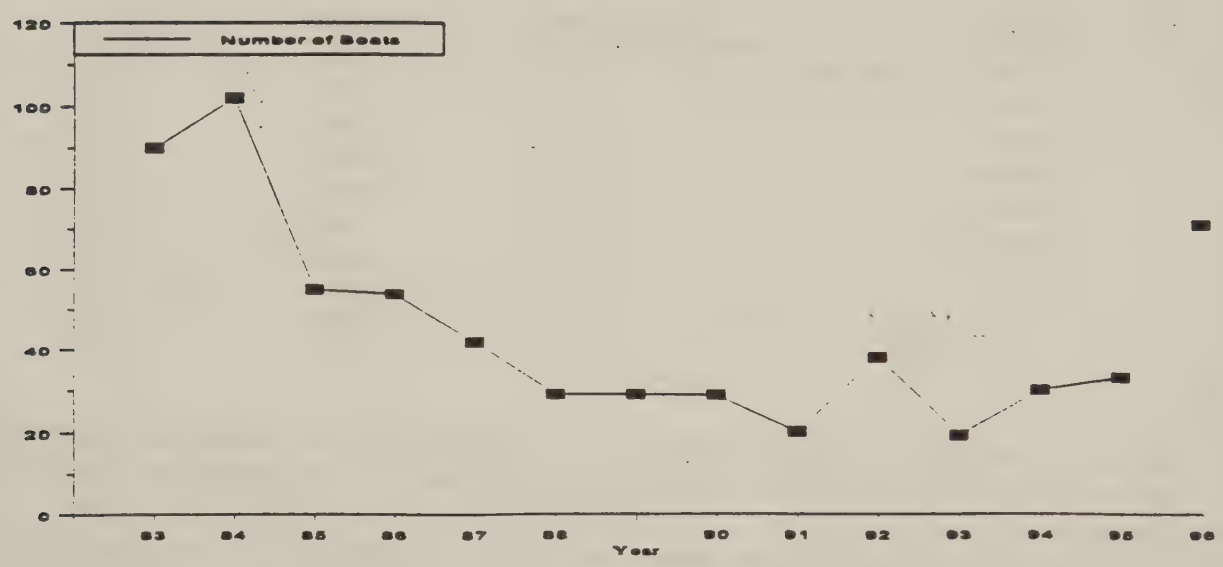
Species	Landings (lb)	Revenue ($)	Ave. Price ($/lb)
Unidentified Bottomfish	6277	16307	2.60
Jacks	1357	3764	2.77
Gindai	2762	9204	3.33
Grouper	9906	28618	2.89
Onaga	15274	67002	4.39
Opakapaka	5256	15907	3.03
Lehi	2543	10056	3.95
Emperor	9592	25850	2.69
Subtotal	52967	176707	3.34

Interpretation: A large improvement in the specificity of bottomfish landings occurred in 1996, with only 12% of the bottomfish landed in 1996 not identified to purchase receipt classification. This improved from 30% in 1995. The primary reason for this was the accurate reporting of one commercial venture harvesting from the Northern Islands of the NMI. This is reflected in the increase in all specified bottomfish categories, but particularly Grouper(Eight-banded grouper was the major source of increase here), Opakapaka, and Emperor, the latter primarily due to the increased harvest of the Red-gilled emperor from Farallon De Medinilla.

Onaga continued to command the highest price per pound, with landings increasing 16% from 1995. All bottomfish prices increased, except for the general category, which would be expected to decline as a lesser percent of the total landed. With improvement in specificity the 'unidentified bottomfish' category is composed of species which do not fit into the suggested categories, and are, as such, species which command a lessar price on the market.

Calculation: Annual summaries for each species from invoice data sheets.

Figure 2. Number of Fishermen (boats) making bottomfish landings



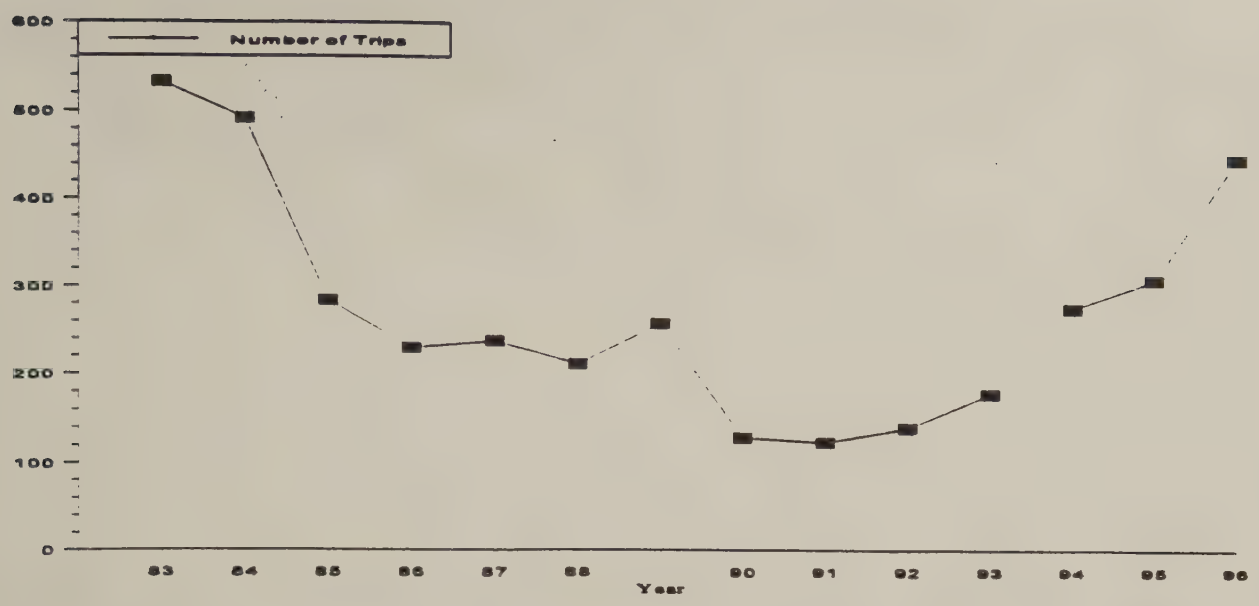
Interpretation: As with the number of trips (Fig. 3), the number of boats or fishermen making commercial landings of any bottomfish species declined from 1984 to 1988, stabilized between 1988-90, slightly increased during 1992, decreased again in 1993, then increased during 1994 and 1995. The number of vessels making bottomfish trips increased over 100% from 1995, to the third highest level since 1983, and the highest since 1984.

More smaller vessels are landing 'mixed' trips over past years. That is smaller vessels are both trolling and Bottom fishing on a single trip.

Calculation: The fisherman or boats selling the catch is identified on the "trip ticket" invoices used by purchasers. The plot shows the number of unique fishermen making any landings of bottomfish within a given year.

Year	Boats
1983	90
1984	102
1985	55
1986	54
1987	42
1988	29
1989	29
1990	29
1991	20
1992	38
1993	20
1994	32
1995	33
1996	**70**
Average	46
Standard Deviation	26

Figure 3. Number of NMI bottomfish trips

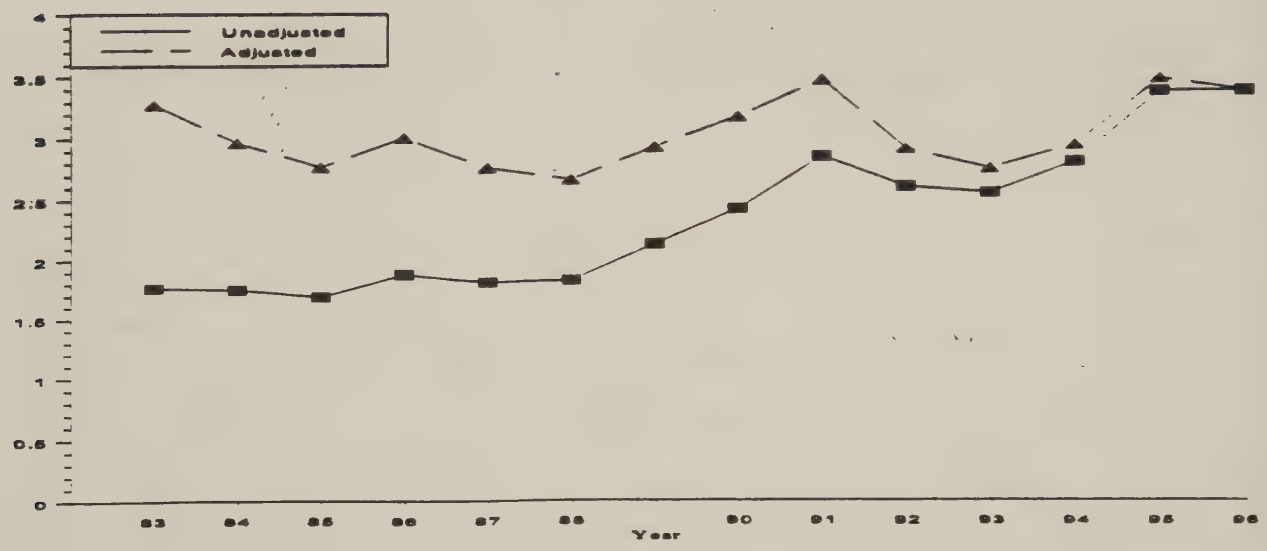


Interpretation: The number of bottomfish trips increased 44% from 1995. This corresponds with the number of vessels making bottomfish trips, as well as the increase in the number of Bottom fishing trips to the Northern Islands.

Calculation: The number of trips which resulted in landing any bottomfish are tallied by adding each recorded fisherman's trip on a given day. The assumptions are that each fisherman lands only once in a given day, and that he sells all of his catch on that day. Most trips last a single day, but it is also known that the occurrence of longer fishing trips is increasing.

Year	Trips
1983	533
1984	492
1985	283
1986	229
1987	237
1988	211
1989	257
1990	129
1991	124
1992	140
1993	178
1994	275
1995	309
1996	**446**
Average	275
Standard Deviation	131

Figure 4. NMI average price of bottomfish



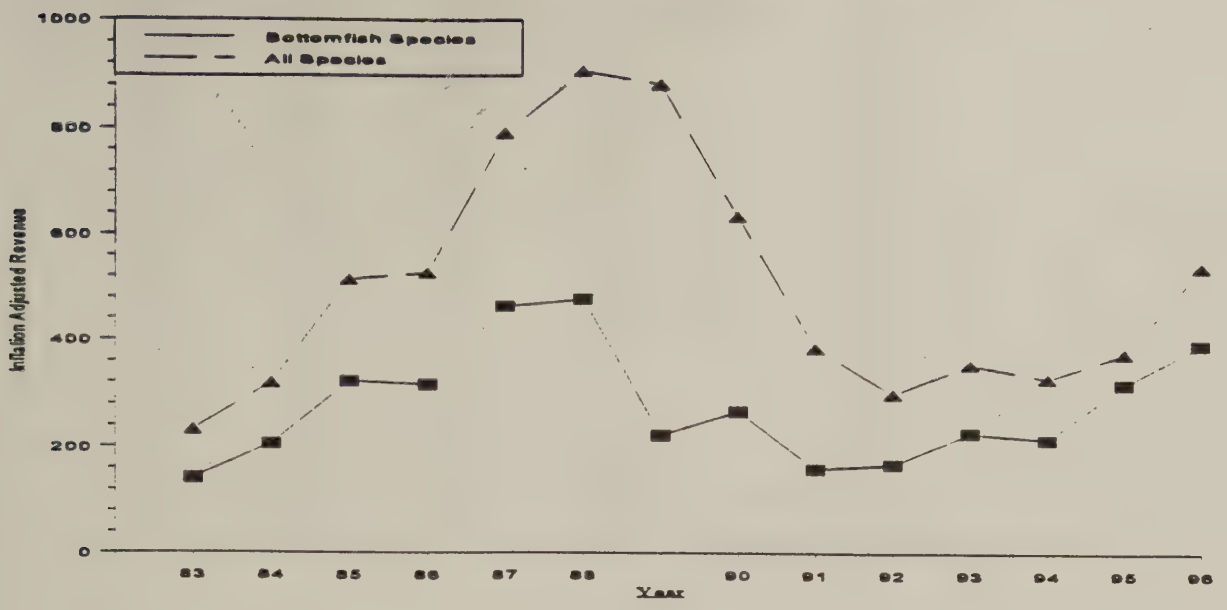
Interpretation: The average price increased steadily from 1988 to 1991, where it reached what was once a record high of $2.83. In 1995 the price increased to a new record high of $3.34. This price remained constant in 1996. This increase was due to the large volume of bottomfish being landed and sold to more establishments as was the case in 1994. Re-sold catches are not included in this report.

Calculation: The average price of the bottomfish complex is calculated by dividing the total revenue by the total landings.

The inflation adjustment is made using the Consumer Price Index (CPI) and establishing the 1995 CPI figure as the basis by which calculations of previous years' prices are made. The CPIs for 1983-87 were not available from the appropriate NMI agency and were, therefore, estimated by using Guam's annual inflation rate to proportionately adjust the 1988 NMI CPI.

Year	Unadjusted $/lb	Adjusted $/lb
1983	1.76	3.28
1984	1.74	2.97
1985	1.69	2.77
1986	1.88	3.01
1987	1.81	2.76
1988	1.82	2.66
1989	2.12	2.92
1990	2.41	3.16
1991	2.83	3.45
1992	2.58	2.89
1993	2.53	2.73
1994	2.77	2.91
1995	3.34	3.44
1996	**3.34**	**3.34**
Average	2.33	3.02
Standard deviation	0.59	0.27

Figure 5. NMI average inflation adjusted revenue per trip landing bottomfish



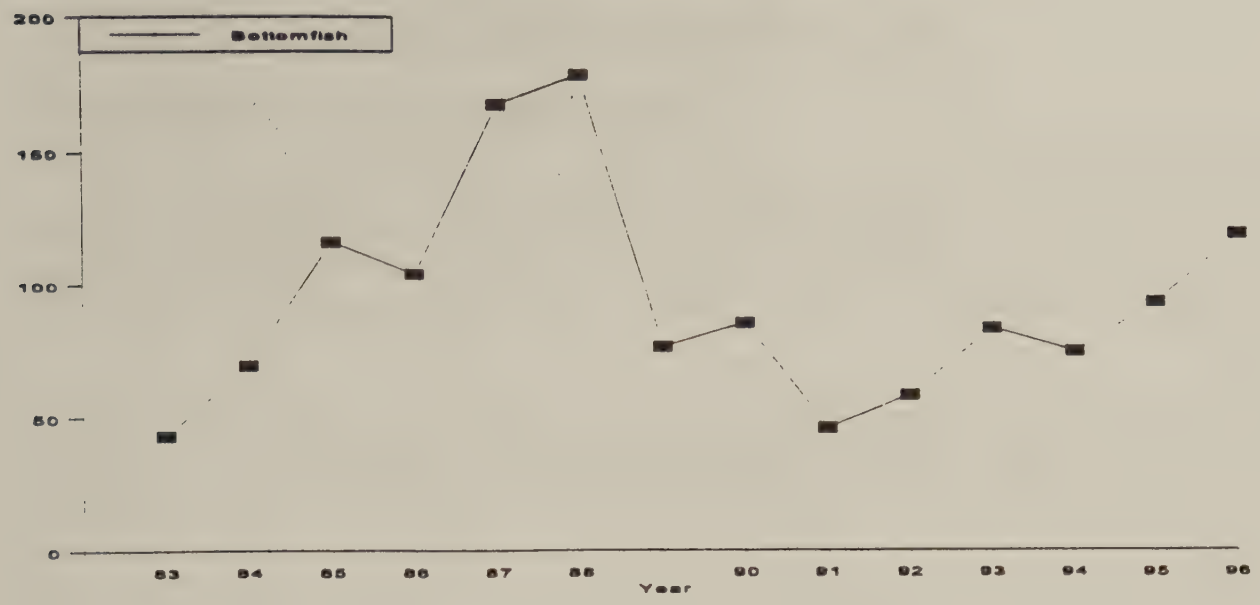
Interpretation: Inflation adjusted bottomfish revenue in 1996 increased over 1995, continuing a trend begun in 1995. The all species inflation adjusted revenue increased significantly from 1995. Unadjusted revenues for both bottomfish and all species increased from 1995. The bottomfish fishery has always been a small proportion of the total fisheries, but it appears that bottomfish are comprising a relatively higher percentage of the trip revenue on trips where bottomfish were caught.

Calculation: Only trips which landed bottomfish are included in these calculations. "Bottomfish $/Trip" is the total revenue of the bottomfish sold from a trip, and "All Species $/Trip" is the total trip revenue of all species combined (e.g. any pelagic and reef fish which were sold).

The inflation adjustment is made using the Consumer Price Index (CPI) and establishing the 1995 CPI figure as the basis by which calculations of previous years' prices are made. The CPIs for 1983-87 were not available from the appropriate NMI agency and were, therefore, estimated by using Guam's annual inflation rate to proportionately adjust the 1988 NMI CPI.

	Bottomfish Species		All Species	
Year	Unadjusted	Adjusted	Unadjusted	Adjusted
1983	75	140	124	231
1984	120	205	186	318
1985	196	321	314	515
1986	197	315	330	528
1987	303	464	517	791
1988	327	477	621	907
1989	161	222	639	882
1990	204	267	485	635
1991	130	159	316	386
1992	150	168	268	300
1993	210	227	329	355
1994	205	215	313	329
1995	311	320	366	377
1996	**396**	**396**	**541**	**541**
Average	213	278	382	507
Standard Deviation	90	109	156	222

Figure 6. NMI bottomfish catch in average pounds per trip



Interpretation: The average pounds per trip of bottomfish increased 28% over 1995, and 61% over 1994. The substantial increase since 1994 can be attributed to the expanding Northern Islands fishery.

Calculation: The average catch per trip is calculated by dividing the total weight of all bottomfish landings by the number of trips which landed bottomfish, regardless of the amount of bottomfish landed on any given trip. Although the average catch per trip is not a very good measure of CPUE, because it is subject to significant biases (e.g. changes in trip length and relative amounts of Bottom fishing compared to trolling), it is the only measure readily possible from the commercial landings system. It may be possible to improve this measure of CPUE by using only those trips which landed bottomfish exclusively, but that has not yet been done. It is believed that the sample size resulting from this exercise would be extremely small and subject to other biases. It should, however, be investigated in the future.

Year	Pounds per Trip
1983	43
1984	69
1985	116
1986	104
1987	168
1988	179
1989	76
1990	85
1991	46
1992	58
1993	85
1994	74
1995	93
1996	119
Average	94
Standard Deviation	41

Appendix 5. NMFS 1996 Administrative Activities

Northwestern Hawaiian Islands Bottomfish Fisheries

The federal Western Pacific fisheries permits program, administered by the Pacific Area Office, Southwest Region, National Marine Fisheries Service, issued a total of 27 bottomfish fishing permits for the NWHI Mau Zone. In 1996, there were four new permittees, 21 renewals, and two non-renewals resulting in a net increase of four permit holders in the Mau Zone over the previous year (1995 = 23).

Eight permits were issued for the NWHI bottomfish limited access program (Hoomalu Zone). This was three less than the number issued in 1995 due to permit non-renewals resulting from the limited access program's use-it or lose-it permit requirement.

Mau Zone (open access) vessels:	Hoomalu Zone (limited access) vessels:
1. Aikane 49	1. Deborah Ann
2. Amber Rose	2. Fortuna
3. Boomerang	3. Kaimi Kai
4. Dasher II	4. Laysan
5. Daystar (new)	5. Trident
6. Double D	6. Windwalker
7. Honua-Oe	7. no vessel - Godbehere
8. Imua	8. no vessel - Bierce
9. Iwalani	
10. J-Natsuko-O	
11. Jaime Elizabeth	
12. Jenine	
13. Kai Pali	
14. Kealailani	
15. Lady Aud (new)	
16. Lei Alana (new)	
17. Leo Marie	
18. Lisa I	
19. Mana Loa	
20. Manu Aloha O'Ke Kai	
21. Pakahi	
22. Pomaikai (new)	
23. Pursuit (new)	
24. Sea Eagle	
25. Shaman II (new)	
26. Shanatu	
27. Wahine Kapaloa I	

Appendix 6. NMFS 1996 Enforcement Activities

The following report is a combined effort of the U.S. Coast Guard 14th District and the NMFS Southwest Region Office of Enforcement. The report covers the period 1 January 1996 through 31 December 1996.

There were no significant MFCMA law enforcement cases relating to bottomfish/ seamount groundfish fisheries that were prosecuted by the National Marine Fisheries Service or Coast Guard in 1996. Three bottomfish vessels were boarded in the Northwestern Hawaiian Islands and two of the three vessels were cited for only minor non-fishing violations.

The Coast Guard continues to conduct surveillance of the Hancock Seamount area. The Coast Guard utilizes C-130 aircraft and cutters to patrol the Northwest Hawaiian Islands/Hancock Seamount.

Appendix 7. Protected Species and Habitat

Three bottomfish vessel operators completed a Protected Species Workshop required to validate permits for the Ho'omalu and Mau Zones in 1996.

Informal reports from the bottomfish community indicate that Hawaiian monk seals and bottlenose dolphins continue to steal catch from vessels fishing in the Northwestern Hawaiian Islands (NWHI). The National Marine Fisheries Service (NMFS) received no reports of hookings or entanglements in this fishery during 1996 from the Mau Zone or Ho'omalu Zone. However, during instrumentation of a monk seal at French Frigate Shoals for a NMFS research project in April 1996, a bottomfish hook was removed from the jaw of a male seal.

No observers were placed on bottomfish vessels operating in the NWHI in 1996 as all observer effort was directed to the Hawaii-based longline fishery and crustacean fishery.

Appendix 8. 1996 Bottomfish Plan Team Members and associated participants

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Appendix 9. Glossary

TERM	DEFINITION
Alia	Samoan fishing catamaran, about 30 feet long, constructed of aluminum or wood with fiberglass. Used for various fisheries including trolling, longline, and bottomfishing
AP	Advisory Panel. Appointed industry/government/educational representatives functioning in an advisory capacity to the Council.
Armorhead	Groundfish found on the SE Hancock Seamount in the Northwestern Hawaiian Islands
AS	American Samoa. Includes the islands of Tutuila, Manua, Rose and Swains Atolls.
ASDPW	Department of Public Works, American Samoa. Also, DPW.
BARB	Bottomfish Advisory Review Board
BMUS	Bottomfish Management Unit Species, include deep and shallow water bottomfish species
BPT or BT	Bottomfish Plan Team. Advisory body to the Council composed of scientists and fishermen who monitor and manage the fisheries under the jurisdiction of the Bottomfish and Seamount Groundfish FMP.
Bycatch	Fish caught in a fishery but discarded or released, except in a recreational fisheries catch and release program.
Commercial	Commercial fishing, where the catch is intended to be sold, bartered, or traded.
CNMI	Commonwealth of the Northern Mariana Islands. Also, Northern Mariana Islands, Northern Marianas, and NMI. Includes the islands of Saipan, Tinian, Rota, and many others in the Marianas Archipelago.
CPUE	Catch-Per-Unit-Effort. A standard fisheries index usually expressed as numbers of fish caught per unit of gear per unit of time, eg., number of fish per hook per line-hour or number of fish per 1,000 hooks. The term catch rate is sometimes used when data are insufficiently detailed to calculate an accurate CPUE.
DAWR	Division of Aquatic & Wildlife Resources, Territory of Guam.
DBEDT	Department of Business, Economic Development & Tourism, State of Hawaii.
DFW	Division of Fish & Wildlife, Northern Mariana Islands.
DLNR	Department of Land & Natural Resources, State of Hawaii. Parent

DMWR	Department of Marine & Wildlife Resources, American Samoa. Also, MWR.
EEZ	Exclusive Economic Zone, refers to the sovereign waters of a nation, recognized internationally under the United Nations Convention on the Law of the Sea as extending out 200 nautical miles from shore. Within the U.S., the EEZ typically is between three and 200 nautical miles from shore.
ESA	Endangered Species Act. An Act of Congress passed in 1966 that establishes a federal program to protect species of animals whose survival is threatened by habitat destruction, overutilization, disease etc.
FAD	Fish Aggregating Device; a raft or pontoon, usually tethered, and under which, pelagic fish will concentrate.
FDCC	Fishery Data Coordinating Committee, WPRFMC.
FFA	Forum Fisheries Agency. An agency of the South Pacific Forum, which comprises the independent island states of the South Pacific, Australia and New Zealand. The FFA formed to negotiated access agreements between FFA member countries and distant water fishing nations such as Japan and the USA.
FMP	Fishery Management Plan.
Guam	A U.S. territory in the Marianas Archipelago. South of and adjacent to the Commonwealth of Northern Marianas Islands.
Hawaii	U.S. state. See MHI, NWHI. Composed of the islands, atolls and reefs of the Hawaiian Archipelago from Hawai'i to Kure Atoll, except Midway Islands. Capitol - Honolulu.
HDAR	Hawaii Division of Aquatic Resources. Also, DAR.
Hoomalu Zone	Bottomfish management area located in the northwestern Hawaiian Islands, includes area from French Frigate Shoals to Kure, including Hancock seamount.
Incidental Catch	Fish caught that are retained in whole or part, though not necessarily the targeted species. Examples include monchong, opah and sharks.
Interaction	Catch of protected species, which is required to be released. Examples: Hawaiian monk seals, marine turtles and albatrosses.
Mau Zone	Bottomfish management area located north of Kauai created as a qualifying zone to the larger, northern Hoomalu zone.
MFCMA	Magnuson Fishery Conservation and Management Act of 1976. Also, Magnuson-Stevens Fishery Conservation and Management Act of 1996. Sustainable Fisheries Act.

MHI	Main Hawaiian Islands (comprising the islands of Hawai'i, Mau'i, Lana'i, Moloka'i, Kaho'olawe, O'ahu, Kauai', Ni'ihau and Ka'ula).
MSY	Maximum Sustainable Yield.
NMFS	National Marine Fisheries Service, National Oceanic and Atmospheric Administration, Department of Commerce. Also NOAA Fisheries.
NOAA	National Oceanic and Atmospheric Administration, Department of Commerce.
NWHI	Northwestern Hawaiian Islands. All islands in the Hawaiian Archipelago, other than the Main Hawaiian Islands (MHI).
OY	Optimum Yield.
PAO	Pacific Area Office, National Marine Fisheries Service. Also, NMFS/PAO.
Protected	Refers to species which are protected by federal legislation such as the Endangered Species Act, Marine Mammal Protection Act, and Migratory Bird Treaty Act. Examples: monk seals, marine turtles, dolphins.
Recreational	Recreational fishing for sport or pleasure, where the catch is not sold, bartered or traded.
SAFE	Stock Assessment and Fishery Evaluation, NMFS.
Secretary	When capitalized and used in reference to fisheries within the U.S. EEZs, it refers to the U. S. Secretary of Commerce.
SPC	South Pacific Commission. A technical assistance organization comprising the independent states of South Pacific Ocean, dependant territories and the metropolitan countries of Australia, New Zealand, USA and France.
SPR	Spawning Potential Ratio. A term for a method to measure the effects of fishing pressure on a stock by expressing the spawning potential of the fished biomass as a percentage of the unfished virgin biomass. Stocks are deemed to be overfished when the SPR<20%.
SSC	Scientific & Statistical Committee, an advisory body to the Council comprising experts in fisheries, marine biology, oceanography, etc.
Trolling	Fishing by towing lines with lures or live-bait from a moving vessel.
USCG	U.S. Coast Guard, 14th District, Department of Transportation.
USFWS	U.S. Fish & Wildlife Service, Department of Interior. Also, FWS.
VMS	Vessel Monitoring System. A satellite based system for locating and

WPacFIN	Western Pacific Fishery Information Network, NMFS.
WPRFMC	Also, the Council. Western Pacific Regional Fishery Management Council. One of eight nationwide fishery management bodies created by the Magnuson Fisheries Conservation and Management Act pf 1976 to develop and manage domestic fisheries in the U.S. EEZ. Composed of American Samoa, Guam, Hawaii, and Commonwealth of Northern Mariana Islands.

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